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Forthcoming Events.

APRIL 23.

Institute of Metals (Swansea Section):—Annual general meeting at Swansea.

North-East Coast Institution of Engineers and Shipbuilders: General meeting at Newcastle-on-Tyne. "Humber Arm Hydro Electric Scheme," Paper by Harold Thomson, M.Sc.

APRIL 28.

Royal Microscopical Society:—Meeting in London. "Some Micro-Structural Features of Modern Rustless Steels," Paper by J. H. G. Monypenny.

MAY 15-31.

Salonica International Fair, 1926.

JUNE 10-19.

International Foundry Trades' Exhibition, Royal Agricultural Hall, London, N.1.

Institute of British Foundrymen.

APRIL 24.

East Midlands Branch:—Ordinary meeting at Loughborough. "Steel Manufacture," Paper by W. H. Hatfield, D.Met.

Newcastle-on-Tyne Branch:—Annual general meeting and Presidential address, at Newcastle-on-Tyne.

West Riding of Yorkshire Branch:—Annual meeting at Bradford.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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The Non-Ferrous Metals Research Association.

The annual meeting of this Association was held in Birmingham last Tuesday. The sixth annual report, which was submitted, is of considerable interest to our readers, as many of them have been a little anxious as to the attitude which would be assumed by the Department of Industrial and Scientific Research to an allied association—the British Cast Iron Research Association, at the end of the five-year guarantee period. If the latter Association is accorded the same treatment as the former there will be little room for complaint. As a matter of fact an inspection of the work of the B.C.I.R.A. has taken place and the report to be submitted to the Privy Council is understood to be a favourable one. In the case of the Association under review, Government support has been accorded for a further period of five years. Certain serious obligations were imposed on the Association, it being laid down that a gradual increase must be forthcoming from the industry either by increased membership or increased subscriptions. It is pleasing to report that the subscription revenue of the Association has been doubled in comparison with the previous year. The rate of subscription has so far not been advanced, and obviously members are now in the position of participating in £25,000 worth of research instead of £5,000, as was the case only three years ago. As the range of subscription varies between £25 to £250 per annum it will be seen that no firm pays for more than one-hundredth part of the total research expenditure. The percentage of total expenditure devoted to experimental work has risen from 21 per cent. in the early days to over 81 per cent. during the last two years.

Of considerable importance to our readers is the fact that the Department of Scientific and Industrial Research has conceded a special supplementary grant on the £ per £ basis for new membership subscriptions from the following sections: Brass foundry; lead; galvanising; tinplate; electroplating and silver plating. The brass founders have now an excellent opportunity to secure for themselves from an existing organisation, research work of the kind which they themselves can and should determine. There exist in Great Britain large numbers of foundries which devote a small department to the production of non-ferrous castings, and some of these are already members of the B.C.I.R.A. We suggest that where such cases exist an assessment should be made conjointly by the two associations and divided between them in proportions based on either relative value of output or personnel employed. We do feel that some special consideration should be shown to firms supporting a national research organisation and possessing a subsidiary department which could benefit by membership of a second.

Dr. Hutton and his staff of 40 research workers are to be congratulated on the excellent report they have been able to put before the industry for which they cater.

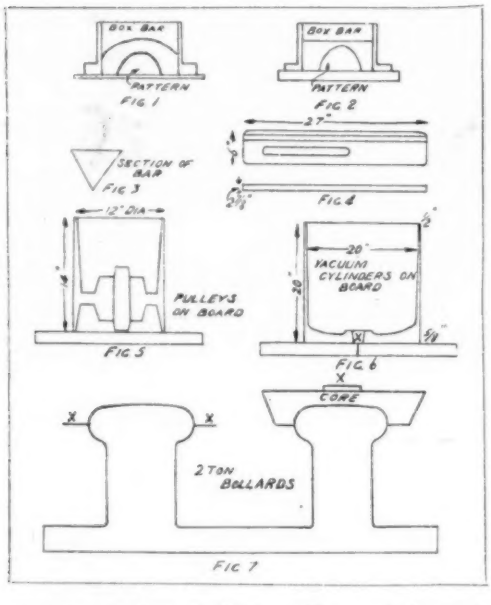
A Few Notions on Jolt Ramming.

By F. G. Barker.

The author has noted with interest the various results achieved with jolt machines, and proposes to outline his personal experience when dealing with machines of 15 tons lifting capacity. In the first place the secret lies in the box-making, referred to on page 136 of the Journal, where Mr. S. H. Russell asks about the influence of bars. Some time ago the Journal illustrated a number of machines, one of which was a Macdonald. Originally this machine was installed for making long struts or bars for textile machines. The author adapted this machine to make electrical lamp-posts. In the first place a bar, as shown in Fig. 1, was made for the first box, and soft places came where the line of sand left the bar. By using the type shown in Fig. 2 in conjunction with lifters no soft places were apparent, and considerable economy was effected in finishing time. It can be demonstrated that lifters hung on bars make no difference in ramming, and when used as in hand moulding they yield similar results.

A bar as shown in Fig. 3 will have similar effect as Fig. 1, but not so marked. In the same foundry it was demonstrated that the bars in the drag part gave trouble, on a simple plain bar, such as a shuttle plate, shown in Fig. 4. When drag plates were used they were satisfactory, the time saved in sand handling being considerable.

When using drag plates, no time need be spent in flat ramming after the machine has been jolted



a given number of times. The sand frame is removed, the plate placed on the top and jolted, thereby saving flat ramming, as the plate accomplished this, saving considerable labour, and yield solid moulds. In some foundries, after jolting, the moulders have to ram under the stays, indicating that such firms are not yet adequately equipped. The trouble lies in the complete lack of provision of adequate sand-handling plants for large machines.

The outside of pulleys have always been rammed up first with riddled black sand, then with usual facing sand, whilst gaggers have been placed in the centre. The whole is filled up and finished off by jolting. Hundreds have been made without rejects after machining. The method is shown in Fig. 5. For vacuum cylinders (Fig. 6) the outside have been jolted up first with black sand, then the centre jolt rammed. The thickness and unusual large body of sand in centre is worthy of note. Actually when the pattern is drawn it lifts out the whole of the middle also. To overcome this a ½-in. dia. hole was inserted at X through the board, etc. It demonstrates the considerable suction induced when using moulding machines. There is room for much skill in applying this.

For the making of 2-ton bollards, a rather unorthodox method was used, but it gave good results, when rammed up as shown in Fig. 7. The cap was made loose, as is indicated at X—X, and was taken off before rolling over. Finally a core as shown was placed in position, surmounted by a bar shown at Y.

Researches on the Nature, Properties and Conditions of Formation of Inter-Metallic Compounds, with Special Reference to Certain Compounds of Tin.*

By W. Hume-Rothery, M.A.

Summary.

PART I.—The theoretical proof of the Phase Rule is discussed. The Phase Rule really involves volume concentrations, but is commonly used for weight composition equilibrium diagrams. This is generally justifiable, but whenever volume changes occur unaccompanied by weight changes, the phase rule in its usual sense will not apply to the weight composition diagram. The proof of the phase rule also involves assumptions regarding the nature of the equilibrium between phases, which are not justified in the case of a solid crystalline compound of the components. When such a compound is formed, the variability of the system is greater than the phase rule indicates.

PART II.—In contrast to other compounds, inter-metallic compounds conduct electricity. They are formed in such a way that some only of the available valency electrons are bound into stable groupings, others being more loosely held. This conception accounts completely for their irregular valency relations. A true binary inter-metallic compound will very rarely give rise to the substitutional type of solid solution, but the interstitial type is possible, although it will usually be limited in extent.

PART III.—A true compound is not present in the β solid solutions of copper, silver, and gold alloys, but these phases approximate to the compositions Cu_3Sn, Cu_3 (or Ag_3)Al, and Cu (or Ag, or Au)Zn. In all of these there is a ratio of 3 valency electrons to 2 atoms, and the phases are regarded as space lattices of electrons and atoms with a fundamental ratio of 3:2, but with no compound molecule in the liquid state. This conception accounts for the electrical properties of these compounds, and agrees with Lindemann's theory of the metallic state. The position of electrons in metallic crystals is discussed.

PART IV.—The freezing point diagram of the system Calcium-Tin is determined. Three compounds are formed, viz.:—$CaSn_3$, Max. on f. pt. curve at 627 deg. C.; d_0 = 6.01); CaSn (break in liquidus curve at 987 deg. C.; d_0 = 4.17); and Ca_2Sn (max. on liquidus at 1,122 deg. C.; d_0 = 3.47). No solid solutions are present. The properties of the compounds are examined, and it is shown that a natural crystal face is oxidised more slowly than a ground or polished section.

PART V.—The freezing point diagram of the system Magnesium-Tin is determined. A very slight range of liquid immiscibility probably exists at the tin end of the diagram. The single compound is Mg_4Sn_3, and not Mg_2Sn. It melts at 778 deg. C., and is blue black with octahedral cleavage.

The compound Na_2Sn is also blue black with octahedral cleavage. It undergoes a remarkable reaction with water, the compound being completely decomposed, but retaining its original form, the whole mass being honeycombed with minute cracks parallel to the octahedral cleavages of the original crystal.

The Detroit Convention.

We are officially informed that applications for particulars of the Detroit Conference can be received up to May 15. They should be sent to Mr. V. Delport at 2-3, Caxton House, Westminster, London, S.W.1.

* A Paper presented to the Spring Meeting of the Institute of Metals.

Aluminium Foundry Practice.*

By George Mortimer.

(*Continued from page* 295.)

Sand Casting.

Moulding Practice.

Any good brass moulder can mould for aluminium with complete success, and without special knowledge of the metal, provided that the castings are of relatively simple design. As the work becomes more intricate, however, he will necessarily meet with problems which follow naturally from four characteristics of the metal. They are:—(*a*) The solid contraction of the light alloys; (*b*) their weakness at high temperatures; (*c*) their high crystallisation shrinkage, and (*d*) their low specific gravity.

Shrinkage and contraction have been deliberately separated in the above, for greater simplicity in explaining their effect on moulding practice.

Solid Contraction.

The pattern scale for 3L11 is one in eighty-four, that for 2L5 one in seventy-eight. In practice a scale of one in eighty meets the case for all the alloys referred to. The solid contraction, then, is on the high side, though in itself insufficient to cause much trouble were it not for the

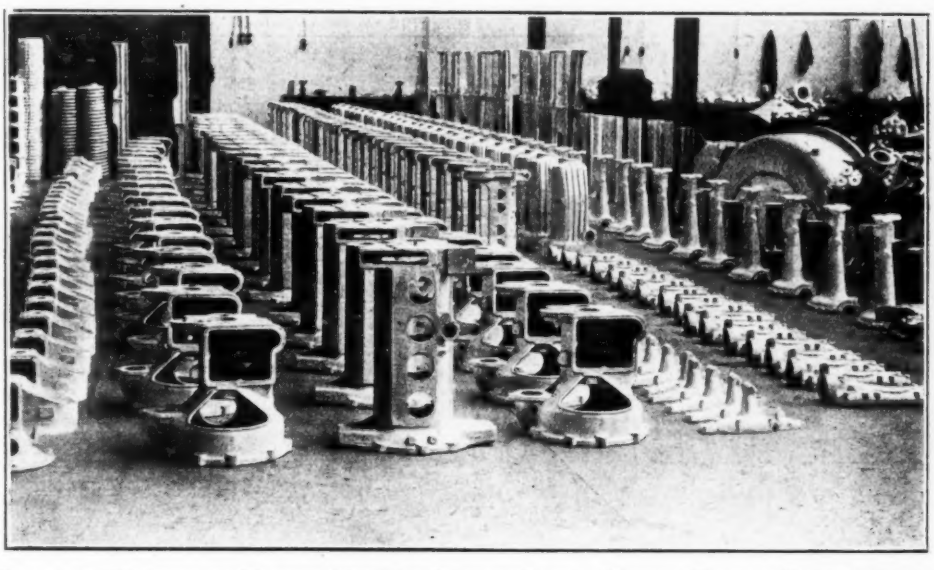


FIG. 6.—A SELECTION OF MACHINE MOULDED CASTINGS MADE BY MESSRS. WILLIAM MILLS, LIMITED, BIRMINGHAM.

Weakness at High Temperatures.

The combination of the two factors at once suggests the most obvious cause for cracked castings. Equally obvious, also, is the remedy. All cores and all sand retained by projections of a casting must be rammed lightly; as lightly and evenly as they can be rammed without collapse on handling, or when the molten metal rushes in. Cores particularly must crush easily. Wherever possible they are made of green-sand, not only because of the great economy of this medium, but also because a green-sand core is less rigid than any other. To enable them to be handled without fracture they are sprayed with treacle and water and skin dried with a floor torch.

Dry-Sand Cores.

Where delicate cores must be made and green sand is found too fragile, they may be either dry sand or oil sand. Dry-sand cores should be used with reserve; they do not "give" easily, and may cause cracked castings; they are, however, economical and practical in many applications, provided this point is borne in mind. Sea sand with a binder which collapses easily when heated up is generally the better, if the more expensive proposition. There are innumerable core binders on the market suitable for aluminium, and the main point to watch is relative cost. A binder which is cheaper in first cost than another, may be more costly in the end if the second can be used with the addition of fifteen parts of water. A resin binder is often advocated, because it softens under heat. It is not popular with moulders, however, on account of the choking fumes set up; and it has a further drawback in the great difficulty of removing cores should the casting happen to cool down before they are knocked out.

Probably the best all-round base for a core binder is linseed oil, and a good mix is made as follows:—Equal parts of linseed oil and molasses, to be used as to one part of this mixture to 25 parts of dry sea sand.

Vital Importance of Light Ramming.

To meet points (*a*) and (*b*), therefore, all that is needed is the use of good, well-tempered green sand, lightly and evenly rammed, together with cores which, whatever their design and their composition, crush under heat with the minimum of effort. All this seems very simple, but one cannot lay too much stress on this necessity for light ramming.

One of the more useful points in regard to machine moulding is just this possibility of consistent ramming. The extent of ramming necessary for any particular job may be found by experiment and fixed for that job, and maintained thereafter with a reasonable consistency. Every founder knows the economic advantages of machine moulding. This particular aspect of machine moulding, as applied to aluminium, and as a useful factor in reducing wasters, is however worth emphasising. It is one of the useful points about aluminium that ordinary green sand, with its natural clay binder is the best of possible materials to use, and that it can be used almost indefinitely. Very gradually, the natural binding effect of the clay content wears off, and this is best met by occasional additions of new sand to the old. The binding action is, of course, brought about by the addition of water. However, the addition of water must not be overdone, or blown castings will result every time. The

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. J. Masters presiding. The Author is associated with Messrs. William Mills, Limited, of Birmingham.

water is best added with a good sprinkler to the heap of sand hot from the mould, for the finest "tempering" is effected by steam, not by drops of water.

Crystallisation Shrinkage.

This is the shrinkage which takes place when the metal passes from the liquid to the solid state, and should be distinguished from the solid contraction which takes place subsequently in the mould. For the alloys discussed, this shrinkage is in the neighbourhood of 7 per cent., and since, of course, it takes place fairly abruptly, it indicates the necessity for providing ample means of feeding thick sections, or alternatively of forcing them to cool at the same rate as the lighter sections. The use of chills and risers is therefore more pronounced than in brass practice, and both are of heavier section.

It would be trite to observe that neither would be necessary given perfect gating, since perfect gating is seldom or never possible of attainment in practice. Because a careful study of gating, however, can result in cutting the 50 per cent. of chills and risers, the following hints are submitted.

Gating.

Since it is advisable to fill the mould with metal at the lowest temperature at which the casting can be poured, it seems reasonable to fill it quickly, and this calls for gates of large capacity. By doing this a pouring temperature may be used many degrees lower than by filling the mould slowly through a small gate. By a large gate, however, we do not necessarily mean one runner of large capacity; it is better practice to use many of small capacity and distribute them logically throughout the mould.

If the mould is poured rapidly at a low temperature, there is risk of entrapping air which has no time to escape before the metal freezes. Hence a common source of blowholes, and hence, also, the necessity for so designing runners that the minimum of turbulence is set up in the incoming metal. For this reason many castings of relatively flat design are best gated from the bottom, so that the rising metal will carry up all air before it. Bottom pouring, however, should be used with discretion; for it is clear that in the case of fairly tall castings the rising metal gives up a good deal of its heat to the surrounding walls. The top of the casting, therefore, is not only cooler than the bottom, but it is also in contact with cooler walls. Thus it must set at the top some time before the bottom freezes, conditions which are exactly what one sets out to avoid in studying gating at all. Such a casting will tend to "hang" in the mould, and will turn out porous, and/or cracked. Gating from the bottom in such a case is also extravagant in waste metal in the gate.

The section of the gate, where it joins the casting, should be so adjusted that it invariably freezes after the adjacent metal in the casting has set. This, of course, varies with every casting, like most other conditions of gating, and it does not necessarily mean that the section of the gate must be larger than the section it is joined to; the sand in the gate is generally hotter than that in the mould. It means that the section must be adjusted until there is no draw, or porosity, in the casting at the point where it enters, and often enough any such defect is at once remedied by allowing a liberal fillet at that point.

Finally, as with all metals, the ideal to aim at in gating is so to arrange its design and disposition that the casting cools at the same rate all over. This means so guiding the path of the metal that heavy sections are filled with cooler metal than thin sections, and needless to say this is seldom attained in practice. It is because it is so difficult to approach with a metal like aluminium that resort is made to the makeshift compromises of chills and risers.

Chills.

Chills are primarily used to ensure reasonably even cooling throughout a casting of varied section. They are unnecessary in a casting of substantially the same section throughout, provided attention is given to logical gating, and to the provision of fillets at sharp corners.

Chills are useful for varied purposes distinct from the above, such as the rapid freezing of a machining strip to obtain a close-grained, hard-wearing surface; or the similar treatment of some local area which must withstand hydraulic tests without leaking.

They may be of iron or brass or aluminium. The most satisfactory are of brass, discounting two minor disadvantages: slight discoloration of the chilled area, and a tendency on the part of the chill to disappear. The use of cast iron overcomes both objections, the metal functioning quite well.

A tendency is noted to place a chill promptly on some area of a casting which shows a crack; this point should be watched, because it is not always obvious to a moulder that the right spot to chill, if any, is some thick section in the neighbourhood which is the prime cause of that crack. To chill the affected area often cures it, but almost invariably sets up some stress or other which results in other cracks elsewhere, and gradually 100 per cent. more chills come into commission.

The use of chills should be avoided wherever possible, if only because of their habit of "sweating," and causing blowholes and "flutters." Molten aluminium reacts strongly to moisture condensed out on the surface of chills, and there is always a tendency to this in a green-sand mould. It is a common slogan in aluminium practice that the moulds should wait for the metal, not the metal for the moulds; and this is sound enough advice. But if the moulds contain many chills and have to wait for long, they should not be closed up until the metal is ready. There are many practical dodges for checking the tendency for chills to sweat, smoking them with a taper, dusting them with French chalk, sand-blasting them, and so on.

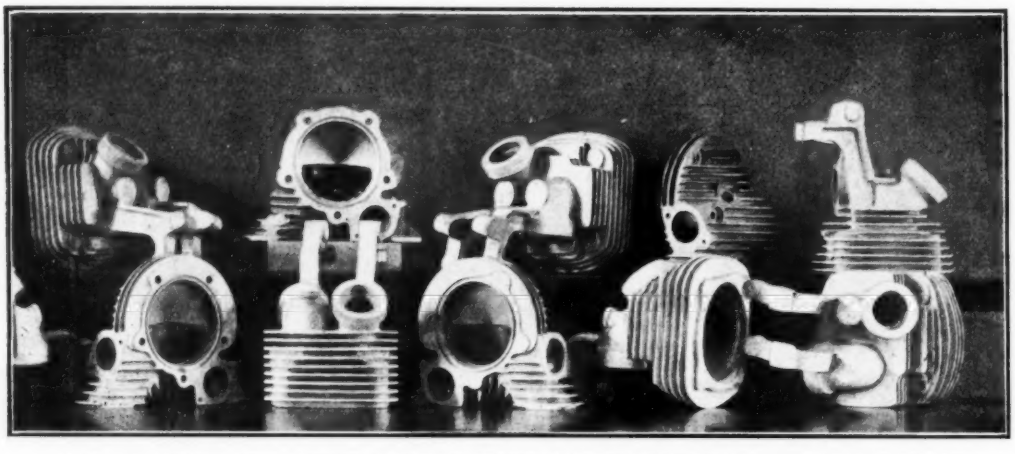


Fig. 7.—Light Aero Engine Cylinder Heads (William Mills, Limited, Birmingham).

The best remedy is to leave out the chills, if good castings can be obtained by attention to gating.

Risers.

Risers are used primarily to feed thick sections, such as bosses, etc., which tend to solidify after the surrounding portions of the casting, thus setting up draws, local sponginess, and contraction stresses.

Risers serve also to give free exit to the air from a rapidly filled mould, to bring up oxide and any other dross collected by the metal. Occasionally they are used to keep an isolated thin section in an otherwise thick casting "live," until the remainder sets; a function which is the exact reverse of chilling.

Because of the high crystallisation shrinkage of these alloys, risers are used more freely, and of heavier section than is normal in brass practice. As in the case of chills, however, their employment can be overdone. The use of risers, their design and placing, deserves more logical consideration than can be the case if this is left entirely to the moulder.

The best gating being admittedly imperfect, a heavy section takes longer to set than an adjacent light section. The light section in freezing draws metal from the still molten heavy section; the

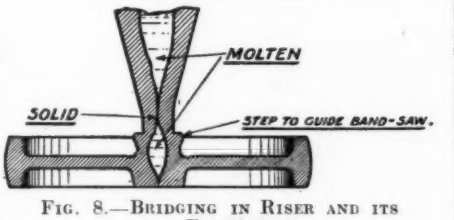


FIG. 8.—BRIDGING IN RISER AND ITS EFFECT.

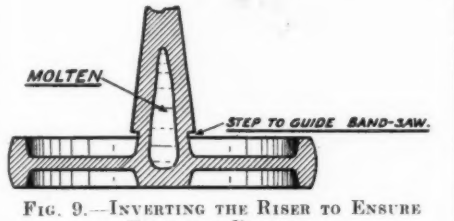


FIG. 9.—INVERTING THE RISER TO ENSURE THOROUGH FEEDING.

latter sets in its turn, and must be fed by artificial means, not only against its own shrinkage, but also to make up for the metal taken from it by the light section. The necessity is shown in the casting by a "draw," or local sinking of the surface, and to cure this one "feeds" that section with a riser or a shrinkage ball.

Alternatively one may chill the section, and so force it to cool at the same rate as the thinner one; but for the moment we are considering those cases where, for one reason or another, a riser is preferred to a chill.

Now, the presence of a heavy riser, properly designed and placed, will feed that section or boss very efficiently. It introduces one further complication, however, in the fact that it tends to keep the section molten for a longer time than previously. It will not give a draw, because the section is properly fed; what it may give, in some instances, is a state of stress in the surrounding part of the casting, due to the solid contraction of the thick section taking place after the thin section has already contracted through much of its range. In a metal so "hot-short" as aluminium this often leads to cracks. The remedy in nine cases out of ten is to use the riser, but to chill the section it is feeding, and to chill it heavily to allow for the extra heat communicated by the riser.

The reason this point is brought forward is because it is often overlooked in practice that two distinct factors have to be faced; the crystallisation shrinkage, and the subsequent solid contraction. A due appreciation of this will save much disappointment to those who, having duly placed a riser to meet a local draw, run into troubles with cracks, the origin of which is not very obvious.

Its common sense is indicated by other considerations. Metal which comes up risers has generally passed over much cold sand, giving up its heat *en route*. It is often, therefore, of lower temperature than the section it is designed to feed; it may freeze before that section, and if this occurs the trouble is accentuated rather than met. The riser draws metal from the section; it does not feed it.

This, in fact, occurs more in practice than would appear probable, and it is due to the form of riser commonly used, which may be described as cone-shaped, with the apex of the cone resting on the section to be fed. There is no objection to such a form beyond this; that it is obviously possible for the metal at the wide upper end to be "live," and to sink as though it were feeding the casting, an appreciable time after the narrow neck near the casting has set. The tendency for the neck to set and to cut off any feeding action, has an analogy in the "bridging" seen in steel ingot practice; both have the same effect in an entire absence of feeding at a time when external appearances give the impression that matters are proceeding according to plan. (See Fig. 8.)

There are two sound methods and one bad one of ensuring that a riser is doing its work as indicated by the molten metal above. The first is to chill the section to be fed, and so force it to set before the riser. The second is to invert the riser, so that the base of the cone rests on the job, not the small end; this gives sure feeding, checks any tendency for the riser to "hang" in the mould, and means less metal melted for a given casting. (See Fig. 9.) It is not always practicable, but where practicable is worth trying.

A Detrimental Practice.

The bad method is to pour "live" metal down the riser as soon as the mould is full. This practice is fairly common, and follows on an observed inefficiency of the riser due to the above causes. It should be thoroughly discouraged as far as aluminium is concerned. Risers bring up with them, in addition to dirt and dross collected by the metal, a fairly tough skin of oxide. Pouring metal down the riser carries this skin, practically unbroken, down into an otherwise sound casting. The presence of the "seam" thus formed is difficult to trace, until some more or less important boss quietly parts company with the casting.

The fact that this does not always, or even very often occur, is one of the worst features about this type of defect and its cause. If a casting broke every time a moulder poured metal down a riser, few moulders who did this would retain their jobs. When a casting does break on service owing to a skin of oxide across a section, however, the fracture looks thoroughly bad, the stress required to break the casting can be almost nil, and "aluminium" is written down as a treacherous material. The method of its manipulation is seldom brought in question.

"Blind" risers have their distinct technical advantages in regard to some aluminium castings, besides the economical one of taking less metal. Such risers are blanked off a few inches above the section they feed, and a vent only is carried on to atmosphere.

Porosity.

It is sometimes found in practice on certain designs of casting, that with the use of the best available materials, careful melting and logically considered feeding of thick sections, an otherwise sound casting will not withstand hydraulic pressure tests. Such a casting could, of course, be doped.

Since doping is at best only patchwork, however, it seems worth while to investigate this tendency to porosity, and given that the above points are in order, in nine cases out of ten the cause will be too slow cooling through the solidification range.

This is best demonstrated by casting a brick of the metal in sand. If it is sliced up and one of the slices is used for a water-tight door, it will be seen at once just how water-tight it is. If those same slices are melted up and the metal

XUM

poured out in a thin sheet on the floor, using the same pouring temperature as before, the casting should now hold a considerable pressure without sweating. The metal is the same, and the melting and pouring temperatures the same; but it has cooled rapidly through the freezing range.

The moral is that the mould must not be heated up locally to the extent of losing its chilling properties. Where there is a casting, such as a thin sump designed to withstand pressure, and of a section which in any case calls for high temperatures for successful running, it will lead to porosity if much metal is passed over the surfaces of the mould to fill heavy and tall risers. It is better to blank them off at the lowest point at which efficient feeding can be accomplished.

Using the Inertia of Incoming Metal.

Incidentally, the blanking off of risers introduces one useful factor in the production of solid, clean-cut castings. For the momentum of the column of metal in the gates, brought abruptly to a standstill, introduces a momentary pressure of very salutary effect in the forcing out of occluded gases, and in pressing an already sluggish material into the finer corners of an intricate mould. Here again, blind risers are not the panacea of all evils; they are not even best practice in a great number of castings. The above remarks are hints, not rules, and a good founder will know how to interpret them.

Low Specific Gravity.

This final point of differentiation between aluminium and the heavier casting materials has as much influence on methods used as any of the others.

The specific gravity of the light casting alloys

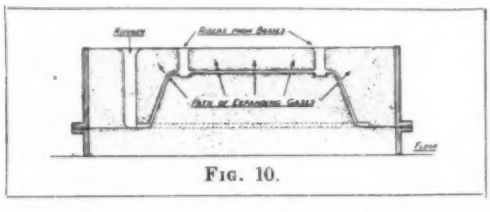


Fig. 10.

dealt with varies between 2.85 and 3.0, or roughly one-third that of brass or iron. From this two points at least arise.

The first is that with metal of so light a weight, venting must be carefully considered and thoroughly carried out. If there is any appreciable back pressure on the escaping gases they will tend to make their way to atmosphere via the molten metal rather than via the vents. This gives rise to blowholes, and/or to a loose, porous, structure at some points, owing to the metal in the vicinity being kept in continual agitation whilst passing through the freezing range. Metal which cannot solidify quietly is spongy when cold.

Effect of the Air Content in the Sand.

This factor is aggravated in connection with aluminium by the necessity for light ramming. Light ramming means a porous mould and core, and it follows that the interstices between sand particles contain in the aggregate much air. Drying the mould helps only to the extent of obviating any action of expanding steam; it does nothing to meet the necessity for the large air content in the sand to expand as it warms up. That expanding air must go somewhere; the point about working with aluminium is that there is much air to deal with, and that owing to the light weight of the metal, the natural tendency is for air to escape through the still molten casting.

The simplest illustration of this is given in a casting such as an aeroplane engine sump, on which the standard of inspection is high, and which is polished all over the exterior. The obvious method to mould this is upside down, since the pattern leaves its own core, which may therefore be of green sand. (See Fig. 10.) To avoid sagging of the core and distortion of the casting, the flask would be firmly bedded on the floor. The effect would be an economical way of moulding an extremely costly casting; costly, because of the high percentage of rejects for minute blowholes and other surface defects, showing up after polishing.

It will be clear that in such a case a very large volume of lightly rammed sand is enclosed on five sides by a thin sheet of molten metal, and that the sixth side is practically blanked off by the floor. Unless unusual precautions are taken in regard to ample vents, the casting would be blown in nine cases out of ten under such conditions. In nine cases out of ten one would get a sound casting if pouring brass.

Two Alternatives.

If this casting were moulded with the open side up (Fig. 11), it would mean a more costly job in the foundry because of the necessity of hanging the core in the mould, and providing one which would hang without sagging or fracture. Yet the author would prefer this method to the alternative remedy (Fig. 12), supporting the first mould on a perforated plate clear of the floor, for two reasons.

It is possible to guarantee a sound casting, because it is known that any dust and loose sand collected by the metal could not float up to the exterior and spoil a highly polished surface with minor specks and blemishes. Because there are many similar jobs met with in practice, meter cases, fuse-boxes, automatic machine parts and so on, this one instance has been dealt with rather

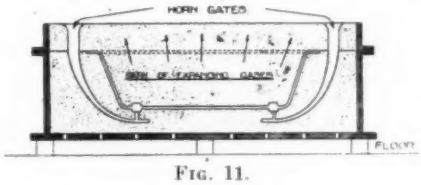


Fig. 11.

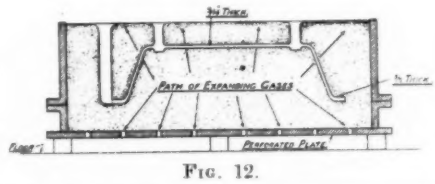


Fig. 12.

fully. Due recognition of the principle will save much trouble where thin, box-like castings are being made, requiring a high finish on the exterior.

Pressure in the Mould.

One further point in dealing with a metal one-third the weight of brass is that logically runners and risers should be three times the usual height to obtain an equivalent pressure in the mould. This is almost always impracticable, but a thick cope should be provided wherever economically possible.

The practice of pouring from a height to obtain an artificial pressure in the mould is not one to be encouraged with aluminium. Its effect is best seen in pouring a glass of beer from a height. One certainly gets a head on it. If not one takes vast care in relative manipulation of bottle and glass. The same care in regard to aluminium is notably absent. In no case is this sort of head wanted in aluminium, since it leads to blowholes, porosity and excessive dross. If extra pressure is wanted in any given casting, there is only one way of getting it in normal foundry routine, by increasing the height of the runners, and either by bringing the risers up to that height or blanking them off as previously described.

(To be continued.)

A verdict of "Accidental death" was returned at an inquest recently at Willenhall respecting the death of Mr. R. Bayley, works manager of the Midland Stamping Works, Willenhall. The evidence given was to the effect that the deceased went to assist with a drop-hammer and was apparently struck by it.

Pattern Shop Aids to Foundry Production.*

By F. C. Edwards, A.M.Inst.Brit.F.

The popular conception of a pattern-shop, as a place where patterns are made to given drawings, is only true in part. It implies that, in making patterns, finality is attained when agreement is secured between pattern and drawing. A more mischievous half-truth would be difficult to find!

The misconception might safely be ignored, but for the fact that it frequently invades the pattern-shop itself. Here, by confining the attention of otherwise skilful craftsmen too completely to the relationship of pattern and drawing—thus obscuring the need for that special equipment which enables a pattern to fulfil its rôle as a tool for the production of castings—it imposes gratuitous handicaps on the foundry.

Actually the pattern-shop, as the intermediary between the designer and the foundryman, functions as a translator. And just as the literal translation of a foreign language is often crude and meaningless, so a pattern may be such a perfect reflection of the blue-print as to be, in service, a very imperfect—or even useless—medium for the production of castings. Something more, indeed, than the shaping of material to conform with the blue-print (admittedly, an art in itself) is required of the pattern-shop. It should present the designer's idea *with such plus or minus modifications* as will facilitate its safe transformation into the actual casting.

This predicates the existence of certain conditions. Of primary importance is the spirit of co-operation, which should actively permeate both departments. Both the pattern-shop and the foundry, of course, has its own peculiar problems, the solving of which require that long personal experience which alone can provide a reliable basis for sound judgment. And although, up to a point, they may be regarded as separate units, it is only through their harmonised efforts that the way to general efficiency lies. Such a spirit emboldens the foundry to express its troubles, and to suggest remedies—thus extending the horizon of the pattern-shop. Gradually the latter acquires the foundry point of view. It realises that a pattern should not only measure up correctly, but must submit to a higher test, that of its behaviour in the foundry.

Such an atmosphere promotes the exercise of pattern-shop initiative. If this is to function efficiently, however (since it may involve some departure from the blue-print), the nature of the service for which the castings are required should be clearly understood. No radical divergence from design—beyond recognised limits, having the complete acquiescence of the drawing office—is here suggested. The designer's idea is most likely to succeed when the pattern-shop is *au fait* with the actual requirements of the castings. For it should be remembered that questions affecting taper, fillets, clearances, machining operations, etc., are continually calling for reasoned decisions on the part of the pattern-shop.

When these conditions are fulfilled pattern-shop aids to foundry production should be abundantly forthcoming. The principal sources are as follow:—(1) Reinforcements in pattern construction as preventives against pattern shrinkage, warping, or ramming out of shape; (2) correct jointing of patterns, to facilitate moulding, and to obviate, as far as possible, unsightly joint marks on the casting; (3) the judicious employment of cores in order to eliminate difficult jointing operations and drawbacks; (4) the provision of ample bearing surfaces for cores, and the generous employment of side taper on core prints to obviate mould disturbance on the withdrawal of the pattern, and to promote accuracy of core location; (5) the adoption of easily-recognisable variations in the forms of core-prints employed for similar, though not identical, cores; (6) the limitation of small loose pieces, so far as practicable, and, where unavoidable, such pieces to be held in position by dovetails or other suitable methods as will render the loose pieces proof against displacement by ramming; (7) facilities for rapping and withdrawing patterns from the mould.

Pattern Reinforcement.

An example of pattern reinforcement is seen in Fig. 1, which represents a pattern of a mouthpiece ring. The job is moulded as shown, and leaves its own core. Lugs A A are required to be cast on opposite sides of the ring. The body of the pattern is built up of segments. A bead, which is required round the bottom edge, is seen wired on in loose sections.

Now if the lugs A were separately attached to the comparatively thin wooden ring, they would probably become loosened by rapping and pattern withdrawal after one or two castings had been made. If the moulder continued to use the pattern further castings might be rejected because of the lugs being bent out of their required plane. In such a case all risk of lug displacement may be eliminated, and the moulder permitted to rap away to his heart's content without fear of reprisals, if both lugs are formed from one continuous piece of wood, B, extending from side to side of the ring and built into the body of the job. The connecting piece B is well tapered, and is "stoppered out" of the mould after the pattern has been withdrawn. An incidental advantage of the connecting bar is that it conveniently carries a rapping plate C. The outside bottom edge of the body of the pattern is slightly recessed so as to form a shoulder for the bead.

It is sometimes possible to arrange reinforcement members in such a manner as to reduce, or to cut out completely the work of stopping-off. An example of this kind is illustrated by Fig. 2, where the stopped-off reinforcement is represented by the sectioned strips D. If such a frame were sent into the foundry without some form of stiffening beyond that supplied by the shape of the required casting, it would need very special care and attention on the part of the moulder to prevent distortion or fracture of the pattern at the corners whilst the job was being rammed up. It will be noted that internal recesses E are cored out in each side of the frame. Such thickened portions form ideal anchorages for pattern reinforcements. The strips D are inserted well into the body of each block and are stopped out automatically when the cores E are placed in position. The extension F, it may be observed, is a continuation of the central reinforcing bar, halved into each end block. With the reinforcement arranged as shown, it is practically impossible to ram the pattern out of the square, and this with no addition to moulding operations.

Wherever battens are used to reinforce a weak plate (it is understood, of course, that they should only be resorted to when other methods of construction fail to give the necessary support), they should be placed on the bottom side of the pattern as moulded. If placed on the top side, they might probably be in the way of the moulding-box bars, besides entailing more or less risk in stopping off.

Pattern Suitability for Moulding.

Before proceeding with the construction of the pattern this point should be definitely settled. Nothing hinders foundry production more than a pattern made the wrong way for moulding. In cases where any considerable part of the pattern projects into the cope, the pattern should be jointed and dowelled along the plane dividing the cope from the drag. This enables the top part of the pattern to be lifted up with the cope. When the latter is turned over, the pattern can be withdrawn as easily as its counterpart in the drag. It should be remembered, however, that the moulder prefers to have as much as possible of the job in the drag. For this reason it is sometimes advisable to build the main body of

* A Paper read before the London Branch of the Institute of British Foundrymen, Mr. G. C. Pierce presiding.

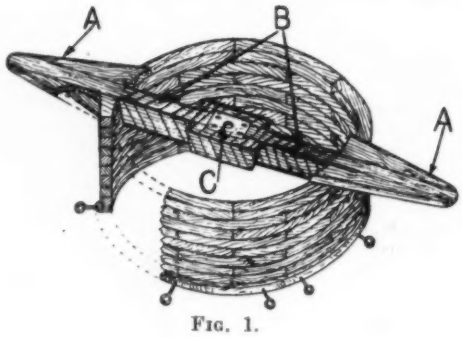


FIG. 1.

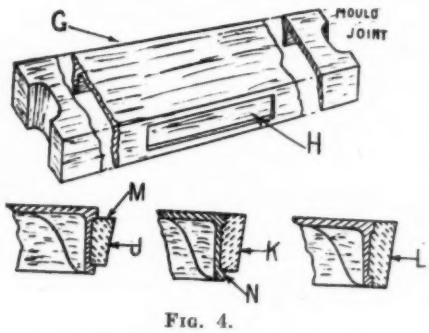


FIG. 4.

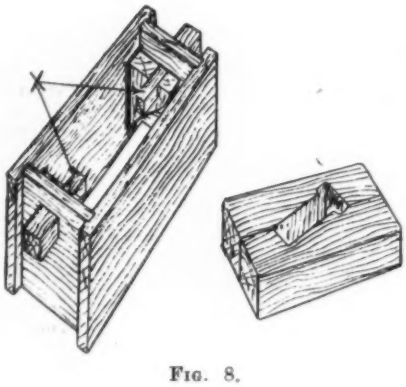


FIG. 8.

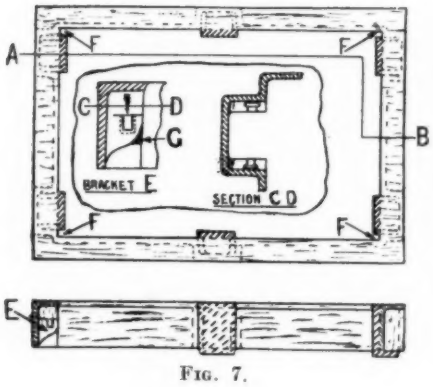


FIG. 7.

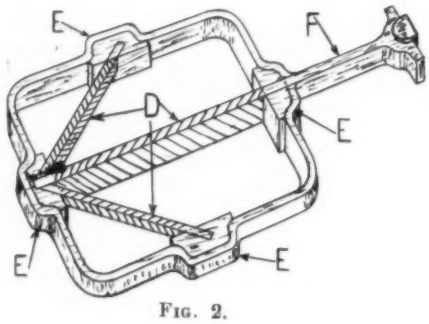


FIG. 2.

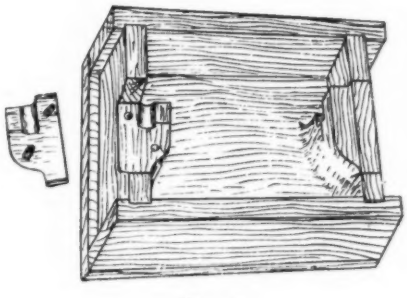


FIG. 9.

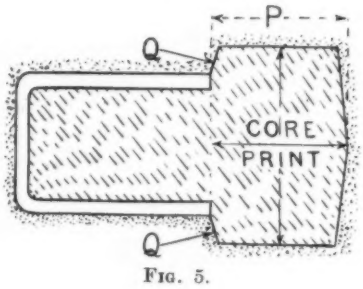


FIG. 5.

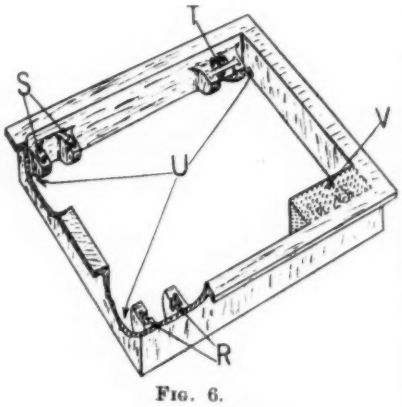


FIG. 6.

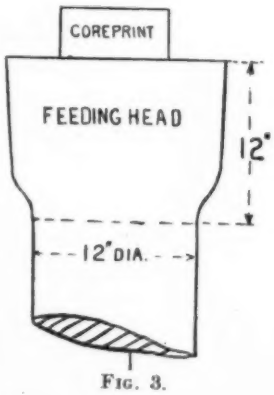


FIG. 3.

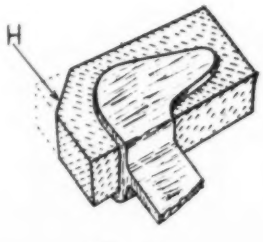


FIG. 10.

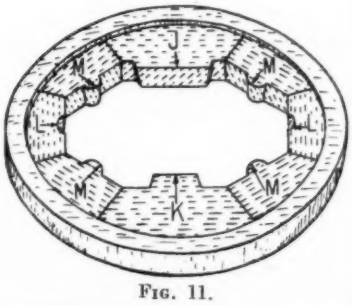


FIG. 11.

the pattern in one piece, and to dowel on loosely such bosses or brackets that unavoidably project into the cope.

Cylindrical Patterns.

Whether cylindrical patterns should be jointed to mould "on the flat," *i.e.*, along their axial plane, or "on end" will depend upon: (1) the requirements of the casting, and (2) upon the moulding boxes available for the job. The pattern-shop can best serve the foundry, in these cases, by making inquiries *before* proceeding with the pattern. Cylinders, rams, etc., will generally require an extension to form the "feeding head" at the end of the pattern proper which is intended to be top as cast. This should be built in as part and parcel of the pattern. It should be of ample proportions according to the size of the job. One should err on the large side, as it is quite as easy to cut off a head, say, 12 in. long as it is to cut off one, say, 8 in. As to the best shape of riser head, there is some difference of opinion amongst foundrymen. The author, however, has found that the best results accrue from the employment of a swelled feeding head, similarly as shown in Fig. 3, in preference to a perfectly straight or plain tapered head.

Replacement of Drawbacks by Cores.

Where cores are used on the outside of a casting as alternatives, say, to drawbacks, the shape and extent of the corepoint will often determine whether such cores are to serve as aids or as hindrances to the foundry. This is especially applicable in dealing with green-sand moulds. For even if the core fits the point perfectly, and is quite flush with the mould, the casting may exhibit different surface levels consequent upon the difference in the relative hardness of the dried core and the green-sand mould respectively.

A case of this kind is illustrated by Fig. 4. Here G represents a frame casting as moulded. A recessed panel is required in one side as at H. This, of course, may either be cored out or taken out with a drawback. Coring the simpler method for the foundry. The coreprints may be arranged in one of the three methods shown respectively at J, K, and L, which represent cross-sections through the panel portion of the pattern. In the case of J, the moulder would either joint down to the level of the top of the point M or cut away the mould to allow of the withdrawal of the pattern, and subsequently make up the mould after the core had been placed in position. It is obviously better to carry the point to the top of the job, as shown at K. This does not exhaust the available aids. For if the point is merely carried down to the bottom of the recess, the lower edge of the casting N—formed as it is from the green-sand mould—would most likely be found very uneven. The best kind of point is that as shown at L, where the core extends the full depth of the job. Incidentally neither the pattern nor the corebox is appreciably more difficult to prepare than in either of the other methods.

Balancing Cores.

Adequate bearing surface for cores also materially aids foundry production. Where a core is likely to "tip," the moulder is compelled to use chaplets, sprigs, etc. This means loss of time, in addition to the increased risk of scrap, on account of the presence of chaplets. A very simple example is seen in Fig. 5, which represents the longitudinal section of a dead-end cylinder. The part of the core P, which takes a bearing in the point, should be heavier than the portion overhanging in the mould. This renders the core completely self-supporting. The taper Q is a further aid; it facilitates the withdrawal both of pattern and core. Moreover, with an overhanging print—*i.e.*, one larger than the diameter of the casting, such a job could be moulded and cast on end, the overhanging portion Q taking the bearing.

In large, heavy cores, even where bearing surfaces at opposite sides of the core rule out all risk of "tipping," it is misguided economy to save wood by cutting down the thickness of the prints. For although the moulder may ram up iron plates on the bearing edges of the prints to obtain a firmer bearing for the core, the width of the core bearing itself—unless the moulder takes anticipatory measures to increase the bearing—will remain that as determined by the print. This, in heavy work, should not be less than 3 to 4 in., or even more.

Coring-up a Box-like Casting.

By adopting methods for eliminating risk of error in coring up moulds, the pattern-shop may save much waste of time in the foundry, besides an occasional batch of scrap castings. The mere removal of doubt, indeed, as to the correct location of cores, must tend to expedite production. The example illustrated in Fig. 6 represents a "box" casting, in which slotted bearings are required in each corner similarly, as shown at R. Now, there are at least three methods in which these bearings can be formed in the box. Single slot coreprints could be employed, as seen at S. One objection to this method is, that if even the print impressions in the (green-sand) mould were exactly as the pattern, the moulder might not maintain their correct alignment in coring up the job Moreover, they come in the cope.

An improvement on this method is to extend the coreprint right across from one bracket to the other, as seen at T. Instead of two separate cores, the slots are now formed by one continuous core; the correct alignment of the bearings is maintained, and the cores rest securely in the drag.

There is, however, room for further improvement. It will be seen that the space, U, between the end brackets and the side of the frame is very restricted. Such a strip of green sand would require to be very securely "rodded" to prevent its becoming dislodged as the job was being poured. This risk could be eliminated by the adoption of plain, block coreprints in each corner of the box, as seen at V, and making a corebox to suit. To add further refinement to the job, the coreprints could be arranged to bring all the cores identical, *i.e.*, made from one corebox. The slots, of course, would be formed in the brackets, as part and parcel of each core—not as separate cores. An incidental advantage is that such block prints add considerably to the strength of the pattern.

Moulding a Bearing Frame.

That the overhauling of long-established methods in the light of advanced practice generally yields profitable results, is as true for the pattern-shop as it is for any other branch of engineering. Figs. 7, 8 and 9 illustrate a typical case in point. In Fig. 7 is seen plan, side elevation, and details of a bearing frame. Cored recesses containing slotted brackets, E, are required at each corner and at the centre of each side.

The pattern was originally made with coreprints projecting from the inside of the frame (shown sectioned in plan). It should be noted, that at each corner of the frame, between the edge of the coreprint and the side of the frame, there is a space, F. As in the previous example (U, Fig. 6), such a space not only causes extra work for the moulder, but may be a source of scrap. The cores were made out of the boxes shown in Fig. 8. Slot cores were made from the small box, dried, and afterwards inserted into the print impressions formed in the large core by the plugs X. This involved further risk of scrap owing to the possible mal-alignment of the slot cores. The method reigned, however, undisturbed for years.

An improved method consists of squaring up the ends of the brackets, E, as shown at G, Fig. 7 (a permissible alteration to design), which allows of a simpler core being made and the offending coreprints eliminated. The corebox is shown in Fig. 9. The brackets are jointed through the slots, which enables the latter to be formed as part and parcel of the main core. This obviates the risk of incorrect alignment of the slot cores. The ends of the brackets, being squared, favour the absence of prints, and the moulding trouble at F automatically disappears. The bottom prints are retained, of course. These, in conjunction with the inside wall of the mould, against which the cores rest, are found to provide adequate bearing surface and support for the cores.

Cores to be Distinguishable.

In those cases where two or more cores in the same job are apparently, though not actually,

XUM

identical, the pattern-shop should take especial care to differentiate clearly between their respective coreprints. It should not be necessary for the moulder, say, to compare cores, to measure them, or to try them against the mould in order to determine their correct location: at the first glance, he should be able to select, from a number of cores, the particular one he may require for any part of the mould. Such locating features should be arranged, of course, so as not to entail, in themselves, any extra work in moulding or coremaking.

The simplest locating "point," both for distinguishing between cores, as well as for indicating their individual orientation, is that commonly used with the square, or rectangular print, as seen at H, Fig. 10. The corner removed should be sufficiently large to avoid possible confusion with those accidentally rubbed off the core by handling: it should be definitely distinctive. A corresponding corner piece must be arranged, of course, in the corebox.

An Example.

How a more complicated job may be dealt with is seen in Fig. 11. Here a circular casting contains variously-shaped internal brackets and bosses. The inside of the mould is formed in eight sections of core. Wherever the sections are identical, the same locating feature is employed. Differences, however, are clearly registered by locating features, which differ, both in shape and size, to such an extent, that there is not much fear of wrong core location. For instance, since J is longer than K, and K is thicker than J, these cores cannot be interchanged without cutting away the mould. The two cores, L, being in every respect identical with each other, are given identical locating features. These, again, are easily seen to differ from those of M; the latter being a projection on the core, and the former a recess. It should be noted, in passing, that ample bearing surface is provided for the cores.

The great possibilities of the oil-sand core open up another field of aids to foundry production, which the pattern-shop will do well to explore. The simplicity with which these cores are made, and the comparatively short space of time required for drying even the largest core, added to the fact that they may be built into a green sand mould several days before casting, with immunity from moisture effect, places them in an altogether different category from that of the old, dry-sand core when the question arises as to the advisability or otherwise of employing cores to save difficult jointing operations, or to form delicate parts of the mould which are likely to break away whilst the pattern is being withdrawn.

Eliminating Mould Repairing.

An example of the latter kind is illustrated by Figs. 12, 13, 14 and 15. Fig. 12 represents the end of a cast-iron bearing frame, 16 ft. long, 2 ft. wide, and 7 in. deep. The pattern, as originally made, is seen in Fig. 13, which explains the method of moulding. The top of the job in the figure—which is the side as moulded—is taken away by means of a specially-constructed drawback box. With regard to the end, it will easily be realised that after the pattern has been given the necessary rapping to enable it to be withdrawn, the mould, especially between the coreprints and facing strips, presents a very dejected appearance. Each end might possibly take half-an-hour to repair. Moreover, the disturbed print impressions would then form very unreliable guides for the slot cores.

When the pattern is arranged, as in Fig. 14, the ends of the frame, being made up as plain, well-tapered blocks, they not only require much less care in ramming up than those as shown in Fig. 13, but easily withdraw from the mould without causing any disturbance whatever. This means that mending-up is not required. Further, instead of having to place the three slot cores separately in the repaired print impressions, the moulder has but one brick-like core to handle. The box for this core is shown in Fig. 15. It will be noted that the slot cores are made as part and parcel of the large core. No variation can thus occur in the centres of the holes.

Made in oil-sand, this core can be produced in the time previously occupied in making the slot cores alone. Incidentally, these cores are made without being vented. Two additional advantages of the block core method, as shown in Fig. 14, are:—(1) Stronger pattern construction, and (2) the corebox can be used for other patterns having the same standard type of end.

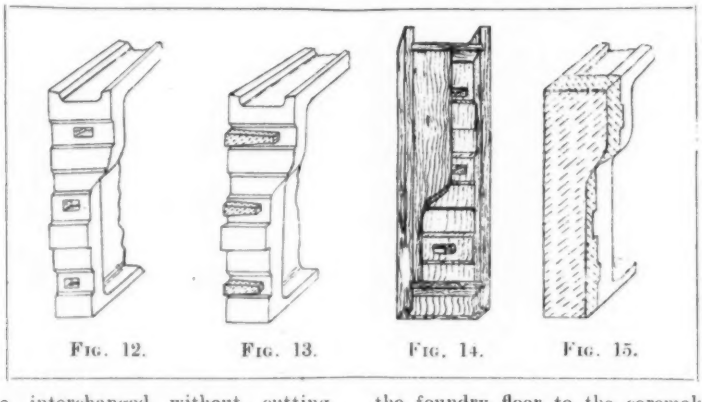


Fig. 12. Fig. 13. Fig. 14. Fig. 15.

Oil-Sand Cores and Economical Production.

The point which is emphasised by the above example is, that an altogether different standard of comparison now obtains between the respective operations of moulding and coremaking than was formerly the case. Thanks to oil sand, difficult moulding problems may now be transferred from the foundry floor to the coremaker's bench *at a greatly reduced overall cost*.

By avoiding the use of loose pieces, wherever practicable, the pattern-shop may indirectly help foundry production. For loose pieces are not only liable to get out of place whilst the job is being rammed up, but may inadvertently be left in the mould to be partly, or completely, burnt away by the molten metal when the job is poured. A slight alteration in design is sometimes all that is necessary to eliminate the need for the loose piece. It is here that the pattern-shop may profitably exercise its advisory functions as the intermediary between drawing office and foundry. In close touch with both departments, and implicitly trusted, as it should be, by each, it can often point the middle path, and thus reconcile conflicting requirements.

Provision for the rapping and withdrawal of patterns from the mould is an aid that is worth much—though it costs little. Its value, especially where a number of castings are required, lies not alone in the fact that it considerably lengthens the life of a pattern, but that it enables a pattern to maintain its accuracy and finish a great deal longer than an unarmoured pattern. The neglect of this provision is *prima facie* evidence that foundry operations have not been completely visualised by the pattern-shop. It suggests the presence of other shortcomings, and the moulder is thus tempted—or, rather, driven—"to take the law into his own hands." The normal foundry procedure where a weighty pattern is devoid of rapping plates, is to accord the roughest type of treatment, usually selecting the weakest portion into which to drive a spike. A weak lug, a fragile bracket, or a badly-

made joint, appear to exercise, at these moments, some fascination. The moulder then proceeds to add insult to injury by opening out the hole with a red-hot poker!

Lifting straps are equally important accessories in the case of deep, or of heavy patterns. They should not be allowed to project into the cope—*i.e.*, the top of the straps should be level with the top of the pattern. This means, of course, that the pattern must be cut away round the hole of the lifting strap. Another method, especially for "boxed-up" patterns, is that of the loose, screwed rod and top and bottom plates.

Importance of Varnishing Patterns.

A well-varnished pattern, whatever may be its other shortcomings, has an air of respectability. This, in itself, is a psychological asset, which easily offsets the cost of the varnish. Respectability commands respect. The moulder who would bruise unmercifully every available part of an unvarnished pattern, instinctively recoils from applying rough treatment to the same pattern when nicely varnished. As a physical preservative, varnish is unquestioned.

The Colouring of Pattern Parts.

Differently coloured varnish should be used to denote metal, core and machined faces respectively. Parts to be stopped-off should also be distinctively marked. It is good practice, also, to paint the pattern number on the job in large figures (it will not, of course, take the place of the raised identification figures which are to appear on the casting). The metal in which the casting is to be made should also be indicated on the pattern. This can be done either by adopting standard colours to represent the respective metals used, or merely by painting the name of the metal or alloy on the pattern. Whether the pattern is to be used directly to obtain the castings, or if it is intended for a metal pattern, should be stated. These are more or less minor aids, but they save subsequent questions, and may prevent scrap.

The above examples, taken as a whole, clearly show that a knowledge of foundry operations is essential to the pattern-shop; that this knowledge, indeed, is the inevitable price to be paid for pattern-shop efficiency. Additionally they suggest that the everyday work of the pattern-maker becomes more and more interesting in proportion as the troubles and pitfalls that beset the moulder are understood. Surely there can be no pleasure comparable to that of visualising, step by step, the various foundry operations of any given job, and arranging pattern and coreboxes accordingly. Smoothing the way here; reinforcing the ground there; barring this dangerous route; rounding that risky corner; and, generally, by the removal of doubt, to ensure a speedy and easy passage to the goal of foundry production.

Mr. A. Griffin and Mr. W. J. Wilson, partners in the firm of the Dart Spring and Safe Company, have provided a large sports ground for their employees at Churchfields, West Bromwich. Mr. A. Griffin performed the opening ceremony last week.

New Process of Surface Hardening of Special Steels.—At the recent meeting of the French Academy of Sciences, M. Léon Guillet, the well-known metallurgist, described a new process of surface-hardening certain special steels. The finished article is placed in a current of ammonia at a temperature of 500 to 510 deg. C. After a time, but only in the case of certain special steels, an extremely hard surface is obtained which, at the end of four days, may obtain a thickness of 0.8 mm. In practice, aluminium steels are, more especially, treated in this way. There is no necessity for quenching, as the steel is hardened by the nitrogen in the ammonia and requires no further treatment. In the case of common steels the impregnation with nitrogen (nitruration) is rapid, and penetrates deeply, forming needles of ferrous or ferric nitride which render the metal extremely brittle. In case of steels alloyed with chrome, silicon, and more especially aluminium, on the other hand, a not very deep crust is formed, which is not very brittle, and is extremely hard, in fact, very much harder than that obtained by cementation or quenching. M. Guillet is continuing his researches.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Cupola Furnace.

To the Editor of The Foundry Trade Journal.

Sir,—Your correspondent, Mr. A. E. Roper, has taken exception to my remarks regarding that little embellishment to the new cupola, *i.e.*, the pressure gauge. I don't for a moment say the instrument is useless, for it tells us the fan is still running and the motive power is still functioning, but alone and without the aid of a Pitot tube it leaves us entirely in the dark as to whether the essential supply of oxygen is being delivered to the carbon in the coke, necessary to cause the reactions required to bring the materials to the liquid state, and so on. I think the foregoing gives the detail covering my original statement, and I said this because I was not conversant with the simple mathematical formula for converting H.P. and pressure into volume displacement, and I, and many more foundrymen like myself, would greatly appreciate any simple formula which, being scientifically and mathematically correct, will enable us rapidly and accurately to ascertain the volume of air actually being delivered to the coke.

Apart from the effective area of the tuyeres not being choked with slag, the pressure does not give a daily register of the volume, because the conditions of resistance are not constant and are difficult to control, and an increase of pressure does not necessarily give proof of greater volume, nor does less pressure indicate less volume, but generally the reverse. Nor does either condition assure us of the amount of that essential element oxygen being supplied, assuming even that we are in possession of Mr. Roper's very useful formula. For the size of the materials charged, which control the resistance, the condition and density of the atmosphere, for we know that on a cold, dry day, or a cold, wet day, we require less volume than on a warm, humid day, which proves, from my way of reasoning and experience, Mr. Roper's contention is not sound.

To anyone working a fan or blower directly driven from a variable speed motor and equipped with ammeter and voltmeter, Mr. Roper's formula would be particularly useful, and answer general practical requirements, but for less money than the cost of the electrical meters named a Campion, or other good English gauge, could be installed, which for foundry purposes is more indispensable than the electrical gauges named, and has the advantage of simple and direct reading.

That there are some cupola makers supplying a reliable and scientifically designed article I don't dispute, but reliance must not be placed on the claims of many cupolas now on the market. Mr. Liardet and Prof. Campion have both contributed able and exhaustive articles to The Foundry Trade Journal on cupola design, the principles of which have been tried and proved, but these principles are quite at variance with many boilermakers' designs on the market.

The remainder of the letter does not directly call for a reply from me, but I am not at all in agreement with Mr. Roper's remarks, except that I would say that American cupolas are designed for American practice, and are only modified designs of English cupolas to meet American conditions.

Cupola design and results achieved received very full treatment by an able foundry engineer—Spretson—in 1876 and very little, if any, advance on sound lines has been added to the best English practice since 20 years earlier than 1876.

In conclusion, from painful experience I am compelled to say that in foundry plant generally, even by the best English, and particularly American makers, there is much that is mechanically unsound and lacking in design to meet the requirements of foundry conditions.—Yours, etc.,

M. J. Cooper.

48, Empress Avenue, Woodford Green,
April 17.

Birmingham University Chair of Metallurgy Change.

Founders all over the world will learn with regret of the forthcoming retirement of Professor T. Turner, who has occupied the Chair of Metallurgy at the University of Birmingham since its foundation.

Professor Turner's classical work in connection with the influence of silicon is known to, and daily used by all founders. No other metallurgical school in the country has given more consistent attention to cast-iron and malleable problems, and Professor Turner's books and papers on the subject are standard.

In the field of non-ferrous metals he has also done much useful and important work, and he might be described as the father of the Institute of Metals, of which for two years he has acted as President. The Iron and Steel Institute accorded to him the highest honours in its power to bestow—the Bessemer Medal.

Professor Turner has established at Birmingham what is perhaps the largest metallurgical school in the country. Birmingham students are found in metallurgical work all over the world, and their services have been utilised to a continually increasing extent by the local industries. Professor Turner's interest in metallurgical work has never resulted in neglect of the purely teaching side of his activities, and he is well known as a charming and able lecturer. He has succeeded in his own department in maintaining an admirable balance between the various fields of metallurgical work, and no section is emphasised at the expense of the remainder. A feature which founders have always appreciated is Professor Turner's readiness to attend meetings and to take part in discussions on metallurgical problems. He regularly attends meetings of the British Cast Iron Research Association, on which he has represented the Iron and Steel Institute since its formation, in addition to acting as a member of the Council and Vice-President. The Association is greatly indebted to him for many services freely rendered, and a similar close connection has existed between him and the British Non-Ferrous Metals Research Association.

There will be a widely felt hope that Professor Turner will long enjoy his period of justly-earned retirement. During the last few years the pressure of his energy has been very considerable, for in addition to his official duties as President of the Institute of Metals and his professorial work, he has been Dean of the Faculty of Science in the University.

Professor Turner's successor in the chair will be Mr. Daniel Hanson, D.Sc. Dr. Hanson is well known in the metallurgical world as one of the most able of the younger generation. He has for many years been one of the chief assistants on the staff of the Metallurgical Department of the National Physical Laboratory at Teddington under Dr. W. Rosenhain. In numerous contributions to ferrous and non-ferrous metallurgy Dr. Hanson has demonstrated his capacity for research of a very high order, and under his guidance there is no doubt that the research traditions of the University will be well maintained.

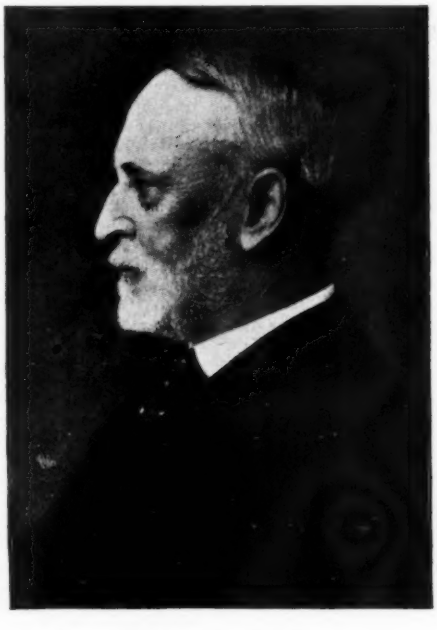
It is of particular interest to note that Dr. Hanson has been personally responsible for the work conducted at the National Physical Laboratory on behalf of the British Cast Iron Research Association, and there is little doubt that the relationship which has been built up between the University and the Research Associations, which make Birmingham their headquarters, will be continued in future.

Dr. Hanson was educated at Wallasey Grammar School and the University of Liverpool. He graduated in the Honours School of Chemistry, and took the degree of M.Sc. for research in metallurgy. For a short time he was on the staff of the Research Department, Woolwich, but left there to join the Scientific Staff of the National Physical Laboratory at the end of 1913, and is now a Principal Assistant in the Metallurgy Department. For the last twelve years he has been engaged upon various scientific researches covering a wide field in ferrous and non-ferrous metallurgy, and has published a large number of scientific papers. His chief work has been in connection with the constitution and properties of aluminium alloys, the constitution of nickel-iron and iron-oxygen alloys, the effects of impurities on copper, and researches into the deformation and fatigue of metals. He is a Member of Council of the Institute of Metals, and was mainly responsible for the formation of the London Section of the Institute, of which he was first Secretary, and later on Chairman.

We think that the University is to be congratulated upon inviting Dr. Hanson to take this post. In some University appointments more weight appears to be given to teaching experience than to capacity for experimental investigation, which is the true inspiration of a specialised school.

Photo] [*Navana.*

Dr. D. Hanson.



Prof. Thos. Turner.

Institute of British Foundrymen.

Scottish Branch.

The annual meeting of the Scottish Branch of the Institute of British Foundrymen was held in the Royal Technical College on Saturday, March 27. Mr. James Affleck, B.Sc., chairman of the Branch, presided, and he was accompanied to the platform by Mr. John Cameron, Kirkintilloch, President of the Institute, and Mr. John Bell, secretary of the Scottish Branch.

The John Surtees Memorial.

The medals and other prizes awarded in connection with the John Surtees Memorial examinations were presented at the outset of the proceedings.

Mr. John Cameron, President of the Institute, introduced to the meeting Miss Mayer, daughter of the late Mr. William Mayer, the founder of the Memorial. Mr. Cameron said that Miss Mayer was the daughter of one of the most enthusiastic presidents that the Institute ever had. As they all knew, he was the founder of this Memorial and the donor of the Surtees Medal, which was competed for alternately by the Glasgow and Newcastle Branches. Mr. Mayer took a keen interest in his work, and was an able and competent foundryman. The work which he (Mr. Cameron) had seen turned out by Mr. Mayer at Dumbarton was of the highest quality. Referring to the value of these examinations to the younger men in the trade, Mr. Cameron said the Institute was opening out very considerably and very wisely in thus encouraging the youngsters to come forward and compete for the awards offered. The work among the juniors was going to be very useful and would ultimately be a great source of strength to the Institute. He had great pleasure in asking Miss Mayer, the daughter of their former President, to present the awards.

Miss Mayer said she regarded it as a great honour to be invited to make the presentations. She was sure her father would have been very pleased to know the high standard attained by the candidates. He would have felt that the object he had in view—the advancement of the foundry industry—had been accomplished. He was always proud to declare himself an enthusiastic foundryman. (Applause.)

The awards were then presented to the following students:—

Senior Section.—Gold medal, James Galt Arnott, Glasgow; and second prize, Thomas Davies.

Junior Section.—Silver medal, Allan Sinclair Meikle, Glasgow; and second prize (equal), William Bell and Norman C. Blyth.

The Chairman said he had to intimate that the prize presented by Mr. David Maclain, of the United States, had been gained by Mr. Robert Macnab. This prize, he said, had been presented by Mr. Maclain in celebration of the appointment of two of his old pupils, Mr. Paterson, of the Newcastle Branch, and Mr. Cameron, of the Glasgow Branch, to the high office of President of the Institute. Referring to the examinations, Mr. Affleck stated that last year, with a view to encouraging the juniors to come into the Institute, they decided to admit into associate membership for one year all those who attended the annual examinations In that way they tried to keep hold of the younger men. He thought they might follow the same course this year also. This was approved.

Mr. Affleck, continuing, said Mr. Cameron had referred very eloquently to Mr. Mayer, and he was sure they all thought of his devoted work on behalf of the Institute. That was the first occasion on which a lady had addressed the Scottish Branch, and he had much pleasure in proposing that they accord Miss Mayer a hearty vote of thanks.

Votes of thanks were also given to Mr. Cameron for coming to take part in the proceedings that day, and to Mr. David Maclain for the valuable prize he had presented to the Branch.

The Business Meeting.

Mr. Bell, secretary, submitted the annual report, in which it was stated that the affairs of the Branch are in a somewhat healthier condition than at the corresponding date of last year. They are not, however, in such a condition that the members can afford to be satisfied, and a stronger effort must be made if they are to keep their position secure and the membership adequate to the responsibilities and the prestige of the Branch. The membership now stood at 208, compared with 197 at the corresponding date of last session. During the session the Branch lost 10 members and added 21. An examination of the details of membership shows that the number of new members enrolled is exactly the same as in the previous session, but the losses are much less. No names have been struck off the register during the session, but it was probable, the report stated, that a revision of the membership roll would be necessary in the near future, and if the membership is not to be reduced below the figures for last session a considerable increase of new members must be obtained.

It is gratifying to record that the Paisley section, to which reference was made a year ago, was inaugurated at the beginning of the present session, and four very successful meetings were held. It is hoped that this section will form a very valuable outpost for the Scottish Branch, and that the meetings will continue to receive a generous measure of support from all those in the Paisley district associated with the foundry trade. An innovation to which reference may be made is the showing of cinema films at Branch meetings. The educational value of the cinema is being rapidly developed by many industrial firms, and while not many of these are directly connected with the foundry, the showing of such as are likely to be of general interest to the members will continue to form a feature at the meetings of the Branch. Arangements have been made by the Branch with other technical societies which meet in Glasgow, whereby any of the members of the Institute of Foundrymen will be welcomed at those meetings. The report also contained an abstract of accounts, which showed that the finances of the Branch are in a satisfactory state.

On the motion of the Chairman, seconded by Mr. Lawrie, the report was adopted unanimously.

Election of Office Bearers.

The Chairman also moved the adoption of the recommendation of the Council, that the various offices be filled as follows:—Mr. A. F. Mearns, president; Mr. T. Bell, senior vice-president; Mr. J. Longden, junior vice-president; Mr. H. Hyman, D.Ph., Mr. John Arnott, F.I.C., and Mr. D. B. Thomson, members of Council; Mr. J. M. Primrose, Mr. A. Campion, and Mr. James Affleck, B.Sc., representatives to the General Council; and Mr. John Bell, honorary secretary.

The appointments were approved unanimously.

Presentation to the Secretary.

Mr. Cameron said there was another pleasing duty he had to perform before the proceedings terminated. They all knew of the success of the Annual Convention of the Institute, held in June last. They found that when the Convention was over, and all accounts were squared, they had a surplus over, and the Council very wisely decided that they could put it to no better use than to hand it over to Mr. John Bell, secretary to the Convention, for the purchase of a souvenir of the occasion. Mr. Bell had worked very hard in connection with the event, and much of the success of the Convention was due to his efforts. He (Mr. Cameron) was still meeting people who spoke of the pleasure they had had in coming to Glasgow last year. To make the Convention such a success Mr. Bell had the heavy end of the work, ably backed up as he was by Mr. Affleck, chairman of the Branch, and the members of Council. He had now much pleasure in handing over the present to Mr. Bell in recognition of the able manner in which he had carried through the arrangements last year.

Mr. Bell suitably acknowledged the gift.

On the motion of Mr. Campion, a vote of thanks was given to Mr. Affleck, who retires from the chairmanship of the Branch. The proceedings then terminated.

XUM

Lancashire Branch.

The annual meeting of the Lancashire Branch was held on April 10, at the Manchester College of Technology, Mr. J. Masters presiding.

Mr. T. Makemson (Secretary) read his annual report, which stated that during the year the activities of the Branch had been carried on successfully, and there had been an increase of membership. The numbers were now: Members, 110; Associate Members, 185; Associates, 10; and Subscribing Firms, 10. Twenty-one names had been removed from the list owing to resignation or for other reasons, and there had been 37 additions, raising the total membership from the 299, at which it stood 12 months ago, to 315. The average attendance at the meetings was 80. The syllabus had covered several branches of foundry practice, the Council endeavouring to cater for foundrymen with widely differing interests. All the lecturers fulfilled their engagements, but Mr. Melmouth was unable to attend in person, owing to illness, and his Paper was read and the discussion replied to by Mr. G. Batty. The sincere thanks of the Council and the members were due to all these gentlemen. Visits had been made to the works of Leyland Motors, Limited, Leys Malleable Castings Company, Limited, E. Green & Son, Limited, R. & J. Dempster, Limited, Newton Chambers & Company, Limited.

The Burnley Section had had a successful session, and it was impossible to over-emphasise the valuable work it was doing in catering for the needs of the members in that area. The number of members attached was 40. The Junior Section had completed its second session. Reviewing the work done since its inauguration, there could be no doubt that the trouble of organising and managing it had been well worth while. It was not expected that the very large attendance in the first two or three months would be maintained, but the sifting out of the original membership had made the Section a stronger and more useful body. New members were being made, and there was a constant attendance of 80 to 100. The work of the section would be continued and amplified. During the summer visits were made to the Messrs. Armstrong-Whitworth's Openshaw Works and to the works of the Stanton Iron Company.

Mr. H. Jowett had been awarded the I.B.F. diploma for his paper on "Castings for Machine Tools" read before the Burnley Section. Mr. Oliver Stubbs was the Vice-President of the British Cast Iron Association, and the Council of that body included three other members of the Branch, Messrs. Haigh, Dawson and Jolley. Mr. Jolley represented the Branch on the Institute's Test Bar Commitee. Mr. Primrose had been elected a member of the Literary Committee, and Mr. Makemson was on the Finance Committee.

The Council invited suggestions with regard to the syllabus, works visits and other matters. Offers of Papers for the next winter session would be welcomed.

In conclusion, Mr. Makemson tendered his thanks to the President, the Council and the members for their courtesy and assistance.

The balance-sheet showed that the year began with £2 15s. 0½d. in hand; remittances from general office were £114 16s., and 10s. 5d. was received for bank interest. The expenditure was £112 13s. 2d., leaving £5 8s. 3½d. to carry forward. The remittances from the general office were one-third of the amount received in subscriptions, £344 8s. This was £50 less than last year, notwithstanding the increase in membership; the reason was that several members had not paid their subscriptions. The Council pointed out that prompt payment would help to the efficient working of the Branch. The accounts had been audited by Mr. Layfield and Mr. Grandison, and the latter now reported to the meeting that all the books were in perfect order.

Mr. Miles said the members and officers alike had reason to congratulate themselves upon the results of the Branch's work during the year, and their satisfaction was increased by the knowledge that Mr. Makemson retained the office of secretary. It was much to be hoped that he would be spared to do this work for many years. The question of outstanding subscriptions was raised at the meeting of the Branch Council, and arrangements could be made to pay by instalments. He hoped the fact of being in arrear would not induce members to cease attending the meetings.

The report and balance-sheet were passed. A vote of thanks to the retiring officers was moved by Mr. Gilpin. He said they had carried out their duties with credit to themselves and to the Institute. In particular, Mr. Makemson had been a tower of strength. The amount of work that he did was greater than any member imagined.

Mr. Flower, in seconding the motion, made particular reference to the manner in which Mr. Masters had fulfilled his obligations as President under great difficulties.

The resolution was carried by acclamation. Replying to it, the Chairman said the presidency was a great honour, but the burden was very light in comparison with that which devolved upon the Secretary. Great help had been given by the Council.

Mr. Makemson said his duties were indeed onerous, and it would be difficult to carry on without the sympathetic support and co-operation of the President and Council. That had never been lacking, and it was encouraging to know the members appreciated what was done for them.

Election of Officers.

Mr. J. S. G. Primrose moved that Mr. S. G. Smith be elected President for the ensuing year. It would be, he said, the culmination of a long period of service to the Branch. The motion was seconded by Mr. H. Sherburn, who described Mr. Smith as a stalwart of the British Foundrymen's Association and the Institute. The Chairman added that there was not a member of the Branch who had not at some time benefited by Mr. Smith's remarks in the discussions at the meetings or in the trade papers. No one was more pleased than himself that he should be followed by one who would discharge the presidential duties with honour and ability.

The motion was carried by acclamation. Mr. Smith said he was not often at a loss for a word to say, but that was his feeling at the moment. He had to follow in the footsteps of many able Presidents, and he hoped to do so with credit. There was justification for being proud of one's connection with the Lancashire Branch; it was one of the most important in the Institute.

Mr. J. S. G. Primrose was elected Senior Vice-President. For the office of Junior Vice-President, Mr. A. L. Key was proposed by Mr. Miles, who said there was a special reason why this proposal should go through. Mr. Key had already held the office of President, but it was during the war period, when travelling was restricted and he was working at Nottingham, so that he could attend only four of the Branch meetings. By appointing him now Junior Vice-President the members would recognise the work Mr. Key had consistently done for the Branch and put him on the path to a second occupation of the presidency: that would be an honour he merited and a further opportunity of serving the Branch.

Mr. Sherburn seconded the motion, which was agreed to enthusiastically.

Messrs. H. Stead, F. Demain and H. Jowett were elected to serve on the committee for three years. The Secretary announced that Mr. Hill had resigned owing to inability to attend the meetings. To fill the vacancy Mr. J. Nicholls was elected, and will serve for two years. Other elections were:—Auditors, R. P. Layfield and W. H. Grandison. Delegates to General Council, J. Hogg, A. L. Key, R. A. Miles, J. S. G. Primrose, H. Sherburn and W. Jolley.

Finally, Mr. T. Makemson was re-elected Secretary, to the accompaniment of hearty applause.

The Chairman remarked that the Branch had grown to such dimensions that the Secretaryship was becoming almost a full-time job. The Council suggested that an assistant secretary be appointed to help Mr. Makemson.

Mr. C. F. Brereton was elected Assistant Secretary.

A Paper on "Patternmaking" was read by Mr. R. W. Kemlo, of Manchester.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,
(MANCHESTER), LIMITED,
BLACKFRIARS, MANCHESTER.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Electric Furnace Practice.

To the Editor of The Foundry Trade Journal.

Sir,—The letter of G. M. G. on "Electric Furnace Practice" in your issue of April 15, is of much interest, and confirms my experience in the use of rusty material.

The following case which came under my notice when I was abroad may be of interest to your readers. There was a quantity of rusty scrap to be used of about 0.45 carbon, the charge was worked in the usual way and the ingots appeared sound. The pouring samples showed no signs of rising. On slicing the ingots it was quite alarming to find them to contain many "blowholes," as shown in the accompanying photograph. From Table I it will be seen that the silicon and manganese were both high. On controlling the slag conditions during the melting down stage and increasing the carbon content of the charge the difficulty was entirely overcome (see ingot 194), and at the same time the silicon content was lowered.

Table I.—*Composition and Soundness of Electric Steel Ingots.*

Cast No.	C.	Si.	Mn.	
181 ...	0.35	0.44	0.53	aluminium additions.
182 ...	0.27	0.34	0.53	equal in all cases.
186 ...	0.37	0.37	0.57	
184 ...	0.27	0.23	0.50	
194 ...	0.25	0.20	0.49	

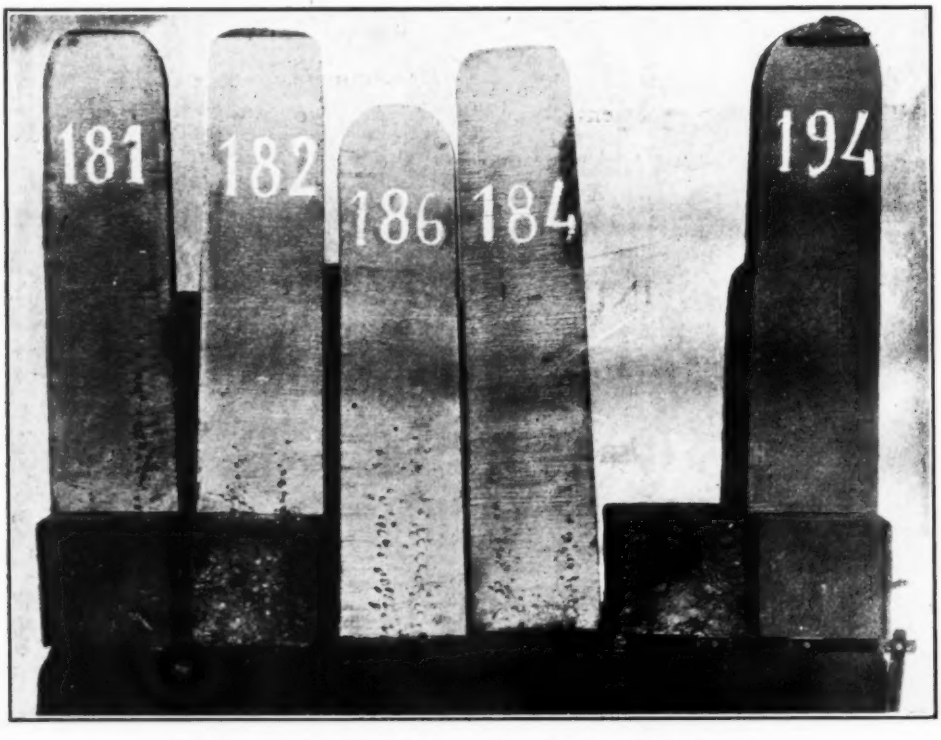
I now also standardise my mixes, and have no difficulty in melting my charge to the desired carbon, but clean material must be used.

My practice in pouring samples is always to rely upon a breaking sample, which is obtained by placing two pieces of ¾-in. square bar bent at right angles at one end of about 1½ in. deep; the two pieces placed opposite form a convenient oblong piece, which with little practice is easily kept uniform. As soon as the sample is solidified, the sample is quenched and broken, the depth of the chill crystals is a good guide to temperature.

Yours, etc.,

A. C. D.

Sheffield, April 17, 1926.



Photograph Showing Blowholes in Electric Steel Ingots.

Striation Due to Working or to Corrosion in Microscopical Metallography. A Contribution to the Study of the Mode of Action of Etching Reagents.*

By A. M. Portevin.

Summary.

There is no phenomenon, however minute or secondary it may appear, which cannot furnish material for interesting study if trouble is taken to examine carefully its mode of occurrence and its appearance. There is, for example, in microscopical metallography the appearance after etching of certain striations produced by the polishing of metals and alloys. This is a well-known fact and a source of great annoyance to all who seek to obtain perfect pictures of the structure free from these scratches; from this point of view they are but nuisances which are, if possible, avoided by suitable methods.

But this annoyance may incidentally become the starting-point for suggestive observations if a closer study is made, particularly in the case of metals and alloys having a crystallisation coarse enough to permit a close survey of the phenomenon on individual grains; for this purpose samples are used which have been very slowly cooled from the liquid, so as to have very well-developed crystal grains; this is what has been done in the case of examples given in this Paper. In addition to this, it is advisable to work on metals and alloys having a low elastic limit, such as copper and solid solutions of brass or aluminium-bronzes which are very rich in copper, in which cases the effects of work due to the polishing scratches are more intense and noticeable to a greater depth. In a previous Paper on etching figures, the author has shown that these constitute one of the decisive characteristics for determining the crystalline state of the grains, and are a definite means for showing the differences of crystalline orientation in these elements of the structure. All disturbances of the crystalline structure, and particularly any deformation of the lattice, must therefore affect the etching figures, which can be developed by suitably etching the surface.

* A Paper presented to the Spring Meeting of the Institute of Metals.

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Trade Talk.

A. G. Wild & Company, Limited, have removed to the Railway Supplies Works, Charlotte Road, Sheffield.

The Boston and Maine Railway in the United States has just purchased 15,000 tons of steel rails from the Krupp plant at Rheinhausen, Germany, and in addition 5,000 tons of tie plates.

The Steel Band Conveyor & Engineering Company, Limited, have removed from Norwich Union Chambers, Congreve Street, Birmingham, to the Barker Street Works, Parade, Birmingham.

Ashmore, Benson, Pease & Company, Limited, of Stockton-on-Tees, are supplying a steel tank and two-lift spiral-guided gasholder of a capacity of 250,000 cub. ft. to the Seaham Harbour Gas Company.

Estate valued for probate at £818,360, with net personalty £802,773, was left by the late Mr. S. Meggitt Johnson, of Endcliffe Court, Sheffield, a director of the Sheffield Forge and Rolling Mills Company, Limited.

The installation of an electrical plant by Mather & Platt, Limited, of Manchester, at Lord Leconfield's Crowgarth iron ore mine, Cleator Moor, is nearing completion and mining developments are expected in the near future.

Mr. Sydney Evans, 9, Bush Lane, Cannon Street, London, E.C.4, has been appointed exclusive British agent for Ketin et Thiriart, of Liege, manufacturers of foundry equipment. Several of the company's sand preparing plants are installed in British foundries.

F. H. Adams, Limited, 263, New John Street West, Birmingham, makers of aluminium alloy and bronze die castings, etc., announce the purchase of a new site, and the proposed erection of large premises, where it is intended to continue their existing business with entirely new equipment.

Considerable damage was caused by a fire which broke out at the North Road Engine Works of the L. & N.E.R. Company, at Darlington, on April 12. The outbreak occurred in the erecting shop, an extensive part of the works, running for a distance of probably 300 yards, with a width of 15 to 20 yards.

The members of the British Acetylene and Welding Association met at the Old Colony Club, Aldwych House, Aldwych, W.C.2, last week, when a paper entitled "Modern Developments in Oxygen Production from the Air" was read by Mr. C. R. Houseman, chief chemist of the British Oxygen Company, Limited.

Mr. J. G. McLean, who has for the last fourteen years been agent and superintending engineer in the North Midlands and North-East Coast of England for Edward Bennis & Company, Limited, has severed his connection with them, and now represents the Crosthwaite Engineering and Furnace Company, Limited, York Street, Leeds, makers of mechanical stokers and furnaces.

Cox & Danks, Limited, Ulster Chambers, 168, Regent Street, London, W.1, were successful last week in raising the ex-German destroyer G.101 at Scapa Flow. This is the fifth of the larger type of destroyers (weighing 1,300 tons) which the company have salved, and is the twenty-fourth to date. There is only one more destroyer to raise, after which the whole of the staff and plant will be engaged upon the salvage of the battle-cruiser "Hindenburg" (weighing 27,000 tons).

The London and North-Eastern Railway Company has placed a contract with Clayton Wagons, Limited, Lincoln, for a steam rail motor coach, and a further order for two cars with the Sentinel Wagon Works, Limited. One hundred bogie brake vans are being supplied by the Metropolitan Carriage, Wagon and Finance Company, Limited, Birmingham, and one hundred four-wheeled brake vans by Stableford & Company, Limited, of Coalville, Leicestershire, to the Buenos Aires Great Southern Railway Company.

The new erecting shop of the London Midland & Scottish Railway at Crewe will be equipped with two 50-ton and two 10-ton high-speed cranes in each of its three bays. The steel works, which are unique among railway establishments in this country, will have two furnaces of 45 ton capacity and two of 70 tons, which will replace several old hand-charged furnaces. The steel produced will be used for manufacturing rails, axles, tyres, and other locomotive parts. The works will be furnished with the most modern equipment, including a mechanical charger for feeding the furnaces, and six new American-type revolving gas machines. The use of compressed air is being extended by the provision of two air compressors of 2,000 cub. ft. each, requiring a 430-h.p. motor for driving. The new installations also include a 5-ton magnet and a vertical plate bending press. The works will have an annual output capacity of about 100 new engines, 1,500 complete overhauls and heavy repairs, and 350 new boilers.

Gazette.

Mr. T. Oldham, Albert Hill, Darlington, iron and steel merchant, has been adjudged bankrupt.

The Briquette Machinery, Limited, is being wound up voluntarily, with Mr. C. W. Tagg, Basildon House, Moorgate, London, E.C.2, as liquidator.

Mr. J. W. Holmes, carrying on business under the style of Holmes Bros., at Canal Road, Crossflatts, Bingley, ironfounder, has had a receiving order made against him.

The shareholders of the Falcon Iron Works (1913), Limited, have decided to wind up the company voluntarily. Mr. J. O. Young, Central Chambers, Fold Street, Bolton, has been appointed liquidator.

A receiving order has been made in connection with the affairs of Mr. E. Wainscott, Church View, Greenmount, near Bury, trading as the Engineering Construction Company, at Castle Chambers, Bury.

The partnership heretofore subsisting between Messrs. T. Humpage, P. A. Thompson and C. C. Hardy, mechanical engineers, Jacob Street, Bristol, under the style of Humpage, Thompson & Hardy, has been dissolved.

Personal.

Mr. Geo. Mortimer, general manager of William Mills, Limited, Grove Street, Birmingham, has left for a business trip to the United States.

Commander Withers has been appointed assistant to Major Small, managing director of the Southern Foundries, Limited, Waddon, in place of Mr. C. Ashwell.

Dr. Henry R. Wright, the newly elected managing director of Siemens Brothers & Company, Limited, who has been a director of Siemens and English Electric Lamp Company, Limited, since January 1, 1923, has been elected managing director of the company, and Mr. S. H. Callow, the sales manager of the company, has been elected a director.

Wills.

Carlisle, The Right Hon. Alexander, Montgomery, of Orme Square, W., for some years general manager and chairman of Harland & Wolff, Limited £81,062

Walker, T., of Tighnord, Causewayhead Road, Stirling, ironfounder, managing director of Robert Melvin, Limited, Alloa £10,102

Weir, G. D., late general manager of the North-Eastern Marine Engine Works, South Docks, Sunderland £25,043

Obituary.

We regret to announce the death of Mr. Cyrus Jones, managing director of J. Grayson Lowood & Company, Limited, Sheffield, at the age of 61. Mr. Jones had been associated with the firm for about 30 years, prior to which he was connected with the Ebbw Vale Steel, Iron & Coal Company, Limited.

Mr. H. Muir died at his residence, 7, Kelvingrove Terrace, Glasgow, on April 7. Mr. Muir was formerly associated with the firm of Muir & Caldwell, Scotia Engine Works. He was 84 years of age, was the son of the late Mr. William Muir, a well-known Glasgow engineer, and he himself attained a prominent position in that business before his retirement some thirty years ago.

Mr. Charles Yeomans, of 17, Broomhall Road, Sheffield, died recently. Educated at Broom Bank House, Sheffield, and the Friends' School, York, Mr. Yeomans served his apprenticeship with the firm of Burys & Company, Limited, Regent Works, Sheffield, after which he was engaged for twenty years in making shear steel and the tilting and forging of cast steel. His firm was known as Yeomans and Eadon, of Highbridge Forge, Owlerton. Over thirty years ago he severed his connection with that firm, and from that time he had carried on an extensive business in Swedish iron and steel.

Mr. Thompson Jowett, of 51, Savoy Court, London, died suddenly at Felixstowe recently at the age of 63. Mr. Jowett was for a time a director of the United Steel Companies, Limited, and he was connected with the Bengal Iron Company. He went to Sheffield to join Samuel Doncaster & Son. Later he joined Wilfred Cocking & Company, and afterwards went into the spring business on his own account, proving very successful. His main interest, however, was the Bengal Iron Company. Mr. Jowett was a member of the board of the United Steel Companies until a severe illness about two years ago.

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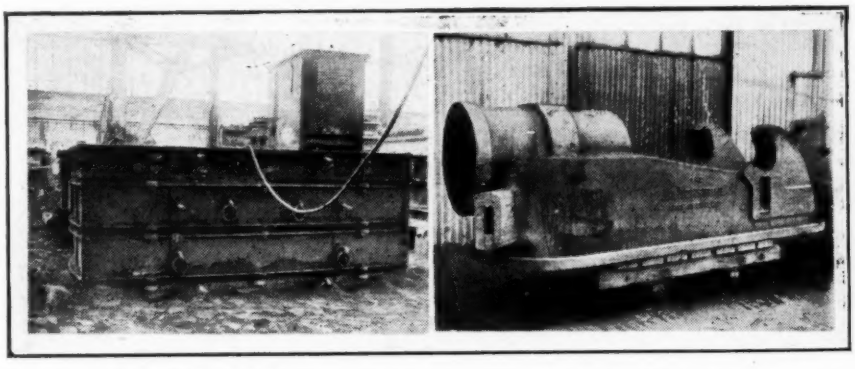
HALVE YOUR FUEL BILL

The application of Oehm's Patent Heating Element results in a 50% saving in fuel consumption, and the cheapest form of fuel—hard coke, breeze and even refuse—can be used. It works twice as quickly as any other method and its use in mould drying results in a BETTER CASTING.



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Above illustration showing the Resultant Casting.

The OEHM'S Patent Heating Element is the simplest and the most efficient apparatus yet devised for producing high temperatures by the conversion of solid fuel to CO_2 gas, possessing pressure and velocity without flame and without smoke.

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IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—For the time being it would appear that business in the Cleveland iron market is practically in suspense, the transactions coming under notice at present being comparatively of unimportant volume, confined entirely to a few urgent orders, although contract deliveries from furnaces are proceeding as usual. No improvement in the conditions thus outlined can be anticipated until the uncertainty now prevailing with regard to the outcome of the miners' dispute is removed by a settlement; and from the attitude of both sides at the moment even the most pessimistic view is distinctly justified. In the circumstances makers continue quotations unchanged, No. 1 being 73s., No. 3 G.M.B. 70s. 6d., No. 4 foundry 69s. 6d., and No. 4 forge 68s. 6d. per ton. These are export figures, home prices being 6d. per ton less.

In the Tees-side hematite market also conditions are extremely quiet, home consumers offering little fresh business, while inquiry from abroad has fallen away owing to the keen competition of Continental material. In the circumstances it is difficult to name a reliable price, but certainly 76s. per ton is now an outside figure for East Coast mixed numbers, with the No. 1 quality 6d. per ton more. On the North-West Coast prices are unchanged, with Bessemer mixed numbers quoted £4 2s. 6d. c.i.f. Welsh ports, £4 5s. 6d. to £4 7s. 6d. per ton delivered at Glasgow, £4 8s. to £4 10s. per ton delivered at Sheffield, and £4 12s. to £4 14s. per ton delivered at Birmingham.

LANCASHIRE.—In view of the obscurity of the labour position, the local markets for foundry pig are perhaps quieter than usual, with little change in current quotations. In the higher-priced makes of Derbyshire iron a little shading is reported, No. 3 quality running from 75s. to 75s. 6d. per ton, delivered into this area. Staffordshire and Lincolnshire No. 3 are quoted at round 76s., and both Scotch No. 3 and West Coast hematite at about 94s., these prices also including delivery into Manchester or equal.

THE MIDLANDS.—In this area the market for foundry pig still shows a very steady tendency, and the furnaces at the moment are not disposed to yield in the matter of price, and, with the uncertain outlook, they are not inclined to sell very far ahead. Ruling quotations are as follow:—Derbyshire No. 3 foundry, 67s. 6d.; Staffordshire No. 3 foundry, 67s. 6d.; Northants No. 3 foundry, 63s. to 63s. 6d.

SCOTLAND.—The outlook in the Scottish iron trade indicates no improvement in conditions, consumers' requirements being still at a minimum average as regards foundry material. With the prospect of an early interruption of fuel supplies, quotations should be firmer, but, in the absence of demand, prices are easier at 76s. for No. 3 at the furnaces.

Finished Iron.

No change for the better can be reported in the market for finished material, and there is plenty of competition for the limited tonnage available, especially in crown iron, where the makers are having to take any price from £11 to £11 5s. delivered this area. There is talk of the Derbyshire, Staffordshire and Lancashire makers coming together to fix the price in this locality for this class of iron. There cannot be much improvement in the call from local works for nut and bolt iron, as the bulk of the business is still going to Belgium, purely on account of the disparity in price, which is very nearly £4 per ton, as the Continental price now quoted is about £6 10s. per ton delivered here, against £10 5s. from the Staffordshire mills. There is some slight improvement in the call for Staffordshire strip, for which the basis price is £12 10s. per ton; marked bars are unchanged at £14 at makers' works, which figure has been operative now since early December.

Steel.

In the Sheffield market there is a quiet, but fairly steady, demand for acid billets, while basic qualities also show some slight improvement. Buying, however, keeps on the small side, and consumers apparently are taking no risks. It is interesting to note that the output of steel in the Sheffield area is gradually increasing, and in February was over 100,000 tons, a record for at least two years. The improvement is, in the main, in open-hearth steel, and, on the whole, plants may be described as busy. A fair lot of railway and shipyard work has recently come into this area; boiler makers have a considerable amount of work in hand, and the light steel trades are well employed. Business in tinplates is still in an unsatisfactory state. Transactions are confined very largely to spot lots and prompt specifications, for which 19s. 3d. is generally quoted, and 19s. 1½d. frequently accepted. Makers are asking more for forward shipment, but buyers are cautious.

Scrap.

The demand for foundry scrap material continues quiet, and in Lancashire only a limited business is reported, with textile machinery scrap quoted at round 70s., ordinary machinery scrap at about 65s., and mild steel scrap at 52s. 6d. to 55s. per ton. In Scotland, first-class heavy machinery cast-iron scrap, suitable for foundries, is easy again, and the price is around 71s. 3d. to 72s. 6d. per ton, with ordinary quality to the same specification 5s. per ton less. Old cast-iron railway chairs are quoted at 73s. 6d. to 74s. 6d. per ton, but with little business doing. Light cast iron and firebars are a little easier at 60s. to 61s. per ton. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Continued weakness in the consumptive demand for copper at home and abroad has had a corresponding effect upon the standard market, values having dropped to new low records for the year, and, in fact, for several years past. London prices for electrolytic copper were not affected to the same extent as the speculative medium, a matter which tended to arouse some little comment, although the fact remains that there has been practically no business put through in the home trade since the holidays. Current quotations:—*Cash*: Thursday, £57 7s. 6d.; Friday, £57 10s.; Monday, £57 5s.; Tuesday, £56 17s. 6d.; Wednesday, £56 15s.

Three Months: Thursday, £58 2s. 6d.; Friday, £58 7s. 6d.; Monday, £58 2s. 6d.; Tuesday, £57 15s.; Wednesday, £57 12s. 6d.

Tin.—Due rather to the disturbed labour outlook at home than to the intrinsic statistical position, which remains exceptionally strong, the standard tin market last week experienced some erratic fluctuations in values, closing, however, at the week-end on a stronger note. In the late dealings there was only very little actual metal coming out, in contrast to the very free offers of forward metal, so that the fall in the latter position became more particularly pronounced, which resulted in the backwardation thereon being increased at one period to fully £12 a ton. Current quotations:—*Cash*: Thursday, £286 15s.; Friday, £285 5s.; Monday, £284 5s.; Tuesday, £279; Wednesday, £281.

Three Months: Thursday, £273 15s.; Friday, £273 5s.; Monday, £271 15s.; Tuesday, £267 5s.; Wednesday, £269 15s.

Spelter.—In sympathy with other non-ferrous metals, and following more liberal offerings from the Continent, zinc prices have again given away, although at the time of writing the metal has regained a trifle. The demand from consumers has been poor, while German consumption has not improved, and consequently much larger supplies of Continental material have been available. Current quotations:—*Ordinary*: Thursday, £32 15s.; Friday, £32 12s. 6d.; Monday, £32 7s. 6d.; Tuesday, £31 17s. 6d.; Wednesday, £31 18s. 9d.

Lead.—The market for soft foreign pig, in common with other sections, has also experienced a superabundance of selling activity, with inevitable heavy liquidation of speculative commitments. Consequently the market has been severely depressed, and the current price for near metal is the lowest seen since 1924, when the market fluctuated between £27 15s. and £44, while the lowest of last year was £30 15s. Current quotations:—*Soft foreign (prompt)*: Thursday, £29 2s. 6d.; Friday, £28 17s. 6d.; Monday, £28 6s. 3d.; Tuesday, £27 17s. 6d.; Wednesday, £27 17s 6d.

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CORNISH MOULDING SAND and CORNISH SILICA CLAY for STEEL CASTINGS.
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CORE COMPOUND

RODS and GRIDS REDUCED TO A MINIMUM.

CORES CAN BE BLACKWASHED WHILE GREEN.

SAME SAND CAN BE USED FOR 12 to 18 MONTHS WITHOUT ADDING NEW.

GIVES CORES A SMOOTHER SURFACE THEREFORE CLEANER CASTINGS AND REDUCED FETTLING COSTS.

NO FUMES OR GASES GIVEN OFF WHILE DRYING or CASTING.

MAKE YOUR FOUNDRY EARN DIVIDENDS.

CORE MAKING REVOLUTIONISED.

PROGRESS AT LAST IN A MUCH NEGLECTED SECTION OF THE FOUNDRY TRADE.

DEMONSTRATIONS ARRANGED.

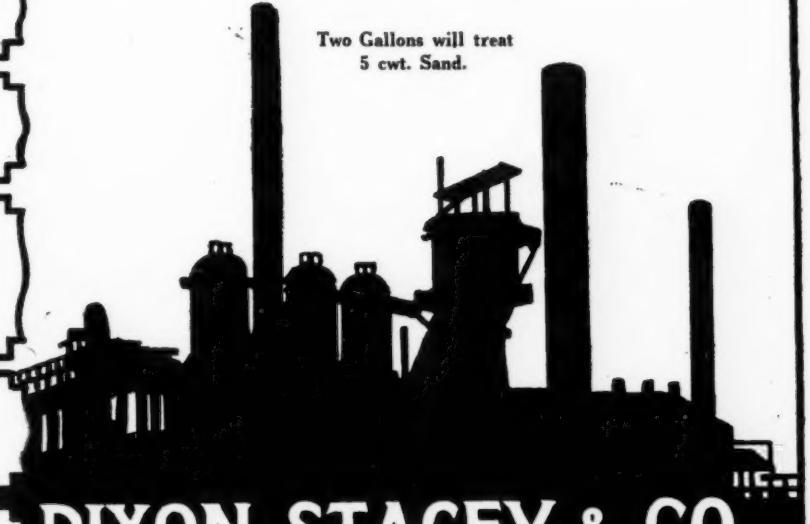
WRITE FOR PRICES AND PARTICULARS.

The most successful Core Binder ever offered.

Makes perfect Cores with spent Core and parting sand.

IN LIQUID FORM SUPPLIED IN 4½, 18, 40 GALL. CASKS

Two Gallons will treat 5 cwt. Sand.



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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	56	15	0
Three months ..	57	12	6
Electrolytic	64	10	0
Tough	59	15	0
Best selected ..	60	5	0
Sheets	90	0	0
India	74	0	0
Wire bars	65	0	0
Do. April	64	15	0
Do. May	64	15	0
Ingot bars	64	15	0
H.C. wire rods ..	69	0	0
Off. av. cash, Mar..	58	13	3 1/2
Do., 3 mths. Mar.	59	12	5
Do., Sttlmnt, Mar.	58	13	0
Do., Electro, Mar.	65	13	7
Do., B.S., Mar. ..	62	10	3 1/2
Aver. spot price copper, Mar. ..	58	13	0 1/2
Do., wire bars, Mar.	65	17	4 1/2
Solid drawn tubes		12	3/4d.
Brazed tubes ..		12	3/4d.
Wire		9	1/2d.

BRASS.

Solid drawn tubes ..	11 3/4d.
Brazed tubes	13 1/4d.
Rods, drawn	10 1/2d.
Rods, extd. or rlld. ..	7 1/2d.
Sheets to 10 w.g ..	10 1/2d.
Wire	9 1/2d.
Rolled metal	9 1/2d.
Yellow metal rods ..	7 1/2d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8 1/2d.

TIN.

	£	s.	d.
Standard cash ..	281	0	0
Three months ..	269	15	0
English	279	0	0
Bars	279	0	0
Straits	287	0	0
Australian	279	15	0
Eastern	267	15	0
Banca	279	5	0
Off. aver. cash, Mar.	292	8	6 3/16
Do., 3 mths., Mar.	283	12	11 15/16
Do., Sttlmt. Mar.	292	8	5 15/16
Aver. spot., Mar.	292	8	6 1/2

SPELTER.

	£	s.	d.
Ordinary	31	18	9
Remelted	32	5	0
Hard	26	5	0
Electro 99.9 ..	35	2	6
English	32	10	0
India	29	0	0
Zinc dust	42	0	0
Zinc ashes	14	0	0
Off. aver., Mar. ..	34	3	4 15/16
Aver., spot, Mar.	34	1	9 1/2

LEAD.

	£	s.	d.
Soft foreign ppt.	27	17	6
English	29	10	0
Off. average, Mar.	31	15	5 5/16
Average spot, Mar.	31	12	6

ZINC SHEETS, &c.

Zinc sheets, English	41	0	0
Do. V.M. ex whf.	38	10	0
Rods	43	0	0
Boiler plates ..	38	10	0
Battery plates ..	38	0	0

ANTIMONY.

Special brands, Eng.	89	10	0
Chinese	75	0	0
Crude	50	0	0

QUICKSILVER.

Quicksilver ..	14	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 10 0
45/50%	11 7 6
75%	20 10 0
Ferro-vanadium—	
35/40%	14/6 lb. va.
Ferro-molybdenum—	
70/75% c. free	6/- lb.
Ferro-titanium—	
23/25% carbonless	11 1/2d. lb.
Ferro-phosphorus, 20/25%, £17 0 0	
Ferro-tungsten—	
80/85%, c.fr. ..	1/9 1/2 lb.
Tungsten metal powder—	
98/99%	2/1 lb.
Ferro-chrome—	
2/4% car. ..	£35 0 0
4/6% car. ..	£22 7 6
6/8% car. ..	£21 15 0
8/10% car. ..	£20 17 6
Ferro-chrome—	
Max. 2% car.	£38 10 0
Max. 1% car.	£44 10 0
Max. 0.70% car.	£54 10 0
70%, carbonless	1/5 1/2 lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£112
Metallic Chromium—	
96/98%	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 0 0
76/80%, packed	£16 0 0
76/80%, export	£14 5 0
Metallic manganese—	
94/96%, carbonless	2/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten ..	s. d. 2 6
Finished bars, 18% tungsten ..	3 0
Per lb. net, d/d buyers' works.	
Extras—	
Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under 1/2 in. to 1/4 in.	3d. lb.
Do. under 1/4 in. to 1/16 in.	1/- lb.
Flats, 1/4 in. × 1/4 in. to under 1 in. × 3/4 in.	3d. lb.
Do. under 1/4 in. × 1/4 in.	1/- lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.
Per lb. net, d/s steel makers' work	

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	7	6	to 3	10	0
Bundled steel & shrngs.	3	3	6	to 3	7	6
Mixed iron & steel	3	1	6	to 3	4	0
Heavy cast iron	3	2	6	to 3	5	0
Good machinery for foundries ..		3	7	6		
Cleveland—						
Heavy steel ..		3	5	0		
Steel turnings ..		2	7	6		
Cast iron borings		2	5	0		
Heavy forge ..		4	5	0		
Bushelled scrap		3	10	0		
Cast-iron scrap		3	7	6		
Lancashire—						
Cast-iron scrap	3	5	0	to 3	10	0
Hvy. wrought ..		3	5	0		
Steel turnings ..		2	2	0		
London — Merchants' buying prices delivered yard.						
Copper (clean)..		50	0	0		
Brass (clean) ..		39	0	0		
Lead (less usual draft)		27	0	0		
Tea lead ..		22	10	0		
Zinc		24	0	0		
New aluminium cuttings ..		80	0	0		
Braziery copper		45	0	0		
Gunmetal ..		45	0	0		
Hollow pewter		180	0	0		
Shaped black pewter ..		132	0	0		

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	72/6
Foundry No. 3 ..	70/-
Foundry No. 4 ..	69/-
Forge No. 4	68/-
Hematite No. 1 ..	76/6
Hematite M/Nos. ..	76/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/6
„ d/d Birm.	93/-
Midlands—	
Staffs common* ..	—
„ No. 4 forge ..	62/6
„ No. 3 foundry	67/-
Shrops. basic	70/-
„ Cold blast, ord.*	185/-
„ „ roll iron* ..	190/-
* d/d Birmingham.	
Northants forge	56/6
„ fdry No. 3 ..	63/3
Derbyshire forge ..	60/6
„ fdry. No. 3 ..	67/6
„ basic	65/-
Scotland—	
Foundry No. 1 ..	81/-
„ No. 3 ..	76/-
Hem. M/Nos.	76/-
Sheffield (d/d district)—	
Derby forge	65/-
„ fdry. No. 3 ..	71/6
Lincs. forge	67/6
„ fdry. No. 3 ..	70/-
E.C. hematite	87/-
W.C. hematite ..	89/-
Lincs. (at furnaces)—	
Forge No. 4	61/6
Foundry No. 3.. ..	64/-
Basic	63/-
Lancashire (d/d eq. Man.)—	
Derby forge	68/-
„ fdry. No. 3 ..	75/3
Northants foundry No. 3	76/-
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	93/6
Glengarnock, No. 3 ..	93/6
Gartsherrie, No. 3 ..	93/6
Monkland No. 3	93/6
Coltness, No. 3	93/6
Shotts, No. 3	93/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	11	0	0	to 12	0	0
Angles		11	10	0		
Tees to 3 united ins.		12	0	0		
Nut and bolt	10	5	0	to 10	7	6
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t. ..		14	0	0		
Gas strip		12	10	0		
Bolts and nuts .. 3/4 in. × 4 in. ..		15	5	0		
Steel—						
Ship plates	7	12	6	to 7	17	6
Boiler plts. ..		11	5	0		
Chequer plts. ..		9	15	0		
Angles	£7	2	6	to 7	5	0
Tees	£8	2	6	to 8	5	0
Joists	£7	2	6	to 7	5	0
Rounds and Squares 3 in. to 5 1/2 ins. ..		7	15	0		
Rounds under 3 in. to 3/8 in.		7	10	0		
Flats, over 5 in. wide and up ..		8	5	0		
Flats, 5in. to 1 1/2 in.		7	5	0		
Rails, heavy ..		8	0	0		
Fishplates		12	0	0		
Hoops (Staffs.) ..		10	10	0		
Black sheets, 24g.		11	5	0		
Galv. cor. sheets, 24g.	15	10	0	to 16	0	0
Galv. fencing wire 8g. plain		14	0	0		
Billets, soft	£6	2	6	to 6	5	0
Billets, hard ..		8	2	6		
Sheet bars	6	0	0	to 6	2	6
Tin bars d/d	6	2	6	to 6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3 1/2
Wire	1	3 1/2
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3 1/2 to 1/9 1/2
To 15 in. wide	1/3 1/2 to 1/9 1/2
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4 1/2 to 1/10 1/2
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5 1/2
Ingots rolled to spoon size ..	1/- to 1/8 1/2
Wire round—	
3/0 to 10 G.	1/6 1/2 to 2/1 1/2

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.26
No. 2 foundry, Valley	20.76
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	21.76
Malleable	22.26
Grey forge	20.76
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.25
Sheets, galv., No. 28 ..	4.50
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb box	$5.50

COKE (at ovens).

Welsh foundry ..	32/6 to 37/6
„ furnace ..	20/- to 25/-
Durham & North.	
„ foundry	30/- to 33/-
„ furnace	14/- to 15/-
Other Districts, foundry	30/- to 33/-
„ „ furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/4 1/2
„	28×20, „	38/9
„	20×10, „	29/-
„	18 1/2×14, „	20/4 1/2
C.W.	20×14, „	17/7 1/2
„	28×20, „	35/1 1/2
„	20×10, „	24/1 1/2
„	18 1/2×14, „	18/4 1/2

Terneplates 28×20, 35/6 per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/15/0 to £16/5/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 5 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Apr. 15	57	7	6	inc. 10/–
,, 16	57	10	0	,, 2/6
,, 19	57	5	0	dec. 5/–
,, 20	56	17	6	,, 7/6
,, 21	56	15	0	,, 2/6

Electrolytic Copper.

	£	s.	d.	
Apr. 15	64	15	0	inc. 10/–
,, 16	65	0	0	,, 5/–
,, 19	64	15	0	dec. 5/–
,, 20	64	10	0	,, 5/–
,, 21	64	10	0	No change

Standard Tin (Cash).

	£	s.	d.	
Apr. 15	286	15	0	inc. 50/–
,, 16	285	5	0	dec. 30/–
,, 19	284	5	0	,, 20/–
,, 20	279	0	0	,, 105/–
,, 21	281	0	0	inc. 40/–

Tin (English ingots).

	£	s.	d.	
Apr. 15	285	5	0	inc. 30/–
,, 16	283	15	0	dec. 30/–
,, 19	282	0	0	,, 35/–
,, 20	277	0	0	,, 100/–
,, 21	279	0	0	inc. 40/–

Zinc Sheets (English).

	£	s.	d.	
Apr. 15	41	0	0	No change
,, 16	41	0	0	,, ,,
,, 19	41	0	0	,, ,,
,, 20	41	0	0	,, ,,
,, 21	41	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Apr. 15	32	15	0	inc. 3/9
,, 16	32	12	6	dec. 2/6
,, 19	32	7	6	,, 5/–
,, 20	31	17	6	,, 10/–
,, 21	31	18	9	inc. 1/3

Lead (English).

	£	s.	d.	
Apr. 15	30	10	0	No change
,, 16	30	10	0	,, ,,
,, 19	30	0	0	dec. 10/–
,, 20	29	10	0	,, 10/–
,, 21	29	10	0	No change

Exports of Iron Castings in March and the three months 1926, compared with March and the three months 1925.

	March, 1925	March, 1926	Three months, 1925	Three months, 1926	March, 1925	March, 1926	Three months, 1925	Three months, 1926
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	147	114	414	396	5,466	3,936	14,401	15,294
,, British South Africa	243	458	904	1,335	9,101	15,885	33,737	45,206
,, ,, East Indies	139	169	447	501	8,060	8,196	23,149	22,003
,, Australia	98	81	235	309	4,941	4,671	12,911	16,637
,, New Zealand	170	240	680	734	8,940	12,316	32,130	35,794
,, Other countries	665	762	1,955	2,015	31,759	35,105	97,939	98,576
Total	1,462	1,824	4,635	5,290	68,267	80,109	214,267	233,510
PIPES AND FITTINGS—								
Cast—								
To Argentine Republic	805	794	2,266	2,029	10,560	9,429	31,076	26,102
,, British South Africa	815	732	1,582	1,886	10,063	9,925	22,410	27,019
,, ,, India	761	842	3,131	2,814	10,819	12,013	45,205	34,647
,, Straits Settlements & Malay States	1,265	495	2,125	5,745	14,338	7,383	23,110	48,358
,, Ceylon	133	140	444	928	1,523	1,706	5,687	10,120
,, Australia	75	673	750	1,732	1,664	8,422	11,804	22,358
,, Other countries	3,768	6,064	11,942	14,811	58,050	74,208	190,178	198,747
Total	7,622	9,740	22,240	29,945	107,017	123,086	329,470	367,351
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	835	722	2,413	2,018	24,737	24,081	75,552	67,837
,, Enamelled	99	82	315	235	8,819	8,093	28,909	25,372
CASTINGS, in the rough—								
Iron	106	208	353	447	3,521	4,901	13,966	12,666
Steel	40	109	119	315	1,467	2,188	4,411	8,317

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Offers should be forwarded in the special envelope provided for the purpose so as to reach the undersigned not later than 9.30 a.m. on Tuesday, the 4th May, 1926.

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